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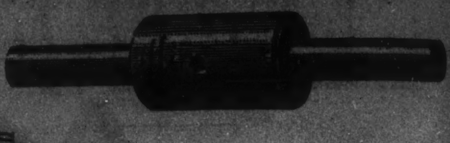

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THE TELEGRAPHIC JOURNAL AND
Electrical Review.
VOL. XVI.—No. 384.

OVERHEAD TELEPHONE WIRES.

MESSRS. UNWIN BROTHERS have published a small pamphlet on "Overhead Telephone Wires"—by whom written it is not stated, yet we think we can trace from internal evidence the source of its inspiration. For his text the writer has taken the Bill now before the House of Lords of the United Telephone Company, which asks for the company increased powers in the extension of its system consequent upon the concessions granted by the late Postmaster-General; and upon this he bases some specious arguments which are intended to prove the great danger to be anticipated from the continuance of overhead wires, and the perfect feasibility of working without loss of efficiency by means of wires carried under ground. We find it more difficult than the author of this pamphlet to arrive at such positive conclusions: we are by no means convinced of the thorough practicability of a system of underground telephone wires, especially in the streets of London. Larger preliminary expense there undoubtedly would be; but to the statement that this is the only objection which can be urged against underground wires we beg very decidedly to demur. While it may be, and in fact is, quite possible to obtain an efficient service over short lengths of buried wires, it has yet to be demonstrated that messages can be transmitted and received with coherence over distances such as the Bill before Parliament seeks to provide for.

We think it possible and expedient, however, to considerably improve the conditions now governing the use of overhead wires. The danger arising from the breaking of ærial lines has been greatly exaggerated, in proof whereof it may be asserted that as yet but two or three instances have come to light of serious injury having been sustained through the falling of a telephone or telegraph wire. It seems to be beyond doubt that a large number of wires in the neighbourhood of the Metropolis as well as further afield were a fortnight ago overweighted and borne down by the heavy fall of snow; but there is no record of any great amount of damage. Allusion is made in the pamphlet to what was recently asserted to be the collapse of the telephone system in Aberdeen; but our readers are aware that Mr. Bennett, the manager in Scotland of the National Telephone Company, put quite a different complexion on this affair from the reports which were first made public, and showed that the occurrence was very greatly magnified. The fact that a number of wires have been broken during recent storms is proof of our proposition that there should be some improvement with respect to the running of these wires; it should be by no means difficult to construct lines or cables capable of withstanding a much greater strain than that caused by the recent snowfall, and the plea urged by Mr. Morgan, the Telephone Company's general manager, when examined before the Select Committee of the House of Commons, that the breakages spoken of occurred under exceptional circumstances, is almost too trivial to be amusing.

The Bill of the Telephone Company is one which will require to be closely watched in its progress through Parliament, for it is very certain that the company will endeavour to secure as many powers as it can possibly hope to get, and some of an arbitrary kind. Some of the clauses may, without much effort, be so read as to confer very far reaching powers upon the company, and it will be necessary to introduce some degree of limitation in these. One or two points occur to us as requiring comment. For instance, the Bill, if passed in its present form, will grant the right to run wires at a height of not less than fifteen feet from any road or street without the consent of the road authority; and the company may also approach to within not less than three feet of any house or building without the consent of owner or occupier. These heights, we feel sure, will have to be considerably extended; fifteen feet is much below the height requisite to clear, for instance, passing fire escapes, and there are other reasons why wires should not be allowed so low. Then again, the company seeks to obtain power to receive the consent of an occupier to affix the necessary attachments for running wires upon premises independently of the owner, and possibly against the wish of the latter; upon the termination of the occupancy, however, all these affixes may be required to be removed. This is a clause which may possibly create considerable difficulty and unpleasantness, and we doubt if it will pass. No reference is made to the payment of compensation in any case except where actual damage is done in running underground wires; but the amount to be paid in the event of damage the company is willing to leave to the Local Government Board to decide where the parties do not agree. Some further provision than this for remuneration will have to be made, we feel sure, for we cannot think that Parliament will permit such an evident amount of power to be placed in the hands of a private company as that which the United Company would have were it allowed to enter upon or go over any person's premises at will.

We are glad to see as we are going to press that the City authorities are about to take this matter into consideration. As will be seen by reference to our "Notes" columns, a motion was introduced at the last meeting of the Commissioners of Sewers to refer the subject to a committee.

The British Association.—The Queen has promised £50 to the guarantee fund in connection with the Aberdeen meeting. The presidency of the 1886 meeting, at Birmingham, has been offered to and accepted by Sir Wm. Dawson, C.M.G., LL.D., F.R.S., Principal of M'Gill College, Montreal.

ELECTRICITY AS A MOTIVE POWER ON RAILWAYS.

By ROMAN, BARON GOSTKOWSKI.

As the use of accumulators is attended with difficulties, it was suggested to avoid them entirely by passing the same current which might have served to charge the accumulators directly into the electro-motor, which is fixed upon the electrical locomotive.

The machine furnishing the current, or the *generator*, as we may call it, is a fixture; whilst the machine receiving the current, or the *recipient*, undergoes changes of place as its movable parts are connected with the wheels of the carriage upon which it has been placed.

If a current circulates the recipient will undergo a progressive movement, whilst the generator remains unmoved at its place. As the distance between both is hereby changed, the conduction by which the current passes from the generator to the recipient must be arranged accordingly.

Siemens, who exhibited the first electric railway of this kind at the Trades' Exhibition at Berlin, in 1879, originally conveyed the current through the rails upon which the carriage with recipient travelled. The arrangement was such that the current coming from the generator arrived at the wheel of the carriage upon which the recipient was fixed by one rail. From thence it passed through the axle, which was divided in its middle, by a non-conductive piece into the coils of the recipient. The end of these was connected with the second portion of the axle, so that the current could pass into the second wheel and the other rail, thus returning to the generator and closing the circuit.

Such a railway has been at work since 1880 between Berlin and the Cadet School of Lichterfelde, and was to be seen at Vienna in the time of the Electrical Exhibition of 1883.

But as the division of the axle certainly does not increase the safety of working, it was proposed to convey the current of the generator to the recipient, not through the rails, but through a peculiar conductor. To this end there was carried along the line a tube slit up below and supported on telegraph posts, in which there played a piston connected by a cable with the recipient in such a manner that the moving carriage drew the piston after it. The electric current traversed the tube, and the piston, passed through the cable to the recipient, whence it returned through the rails to the generator.

Such a line was to be seen at the time of the Paris Exhibition in 1881, and has been at work since the beginning of 1884 between Mödling and Brühl.

A third mode of conveying the current is to be seen at Portrush, in Ireland; here is placed a third rail parallel with the two forming the permanent way. This third rail conveys the current and transmits it to a special contact-brush, which travels on it and has the function of conveying the current to the recipient, whence it can arrive at the running rails and return through these to the generator.

Which of these three methods will prove to be the best can scarcely be foretold. So much is certain, that all three, though for the present not perfect, answer the purpose satisfactorily, so that the conduction of the current is by no means an objection to the application of dynamos for the propulsion of trains.

In order to understand the difficulties which are opposed to the use of dynamos in conveying railway traffic, the following must be considered.

The mechanical work, which must be applied for the generator to furnish a current of i ampère at the tension of E volts, amounts to

$$\frac{i \,.\, \mathrm{E}}{g} \text{ metre-kilogrammes,}$$

g denoting the acceleration of gravitation = 9·81 metres.

The useful work of the recipient will be

$$\frac{i \,.\, e}{g} \text{ metre-kilogrammes,}$$

where e is the electromotive force of the recipient, also expressed in volts.

The work which the recipient yields is naturally smaller than that which the generator receives, as a part of this work is expended on heating the wires of the circuit, and consequently is lost. This loss is:

$$\frac{i}{g}(\mathrm{E} - e)$$

or, for the total resistance, R, of the circuit

$$\frac{i^2 \,.\, \mathrm{R} \,.}{g} \text{ metre-kilogrammes.}$$

It is now necessary in a rational arrangement to reduce this loss to a minimum.

This might be effected (supposing the resistance, R, as unchangeable) by using the weakest possible currents, consequently making i as small as possible.

But as the product of the strength of current and the electromotive force must be constant, since $\frac{i \,.\, e}{g}$ is the expression for the useful work; then if i is diminished, e must be great, which necessitates a good insulation of the coils of the recipient.

In general, the magnitudes e and i must be so selected as to minimise the working cost.

These costs are composed of the outlay for the machinery (generator, conductors, recipient, and motor for driving the generator), and of the cost of the power lost in the conductors. If this sum is minimised the installation will be economical.

It is found in this manner that the loss in conduction amounts to about 30 per cent. of the work yielded by the recipient.

This yield, in connection with experiments on the transmission of power, made in 1883 in the Paris workshops of the Northern Railway of France, leads to the proportion:

$$\frac{e}{\mathrm{E}} = a = 0{\cdot}83.$$

If p denotes the mechanical work furnished by the recipient in kilos per second, we have according to the above the loss of work

$$\frac{i^2 \,\mathrm{R}}{g} = 0{\cdot}3\, p,$$

and with reference to

$$i = \frac{\mathrm{E} - e}{\mathrm{R}} \text{ and } \frac{e}{\mathrm{E}} = 0{\cdot}83$$

there follows finally

$$\mathrm{E} = 10\sqrt{p\,\mathrm{R}}$$

In this equation the total resistance, R, of the circuit must be considered more closely.

According to Uppenborn the installation is most efficient when the internal resistance of the system is $\frac{3}{7}$ of the external.

If the resistance of the generator is denoted by r_1, that of the recipient by r_2, and that of the conductors by r_3, then

$$r_1 = \tfrac{3}{7}(r_2 + r_3).$$

If such a machine is taken for the recipient, as for the generator, then

$$r_1 = r_2,$$

in which case

$$\mathrm{R} = r_1 + r_2 + r_3 = \tfrac{5}{2}\, r_3.$$

If a given conductor of 1 kilometre as it has been experimentally proved upon electric railways, gives $\frac{1}{5}$ ohm resistance, and if the distance between generator and recipient is 1 kilometre then with reference to the conduction and return,

$$r_3 = \tfrac{1}{5} \,.\, 2\; 1 = \tfrac{2}{5}\, 1,$$

in which case $\mathrm{R} = \frac{5}{2} \,.\, \frac{2}{5} \,.\, 1 = 1$ ohm.

If we consider this value of R we have

$$\mathrm{E} = 10\sqrt{p \,.\, \mathrm{I}}$$

a formula from which we can calculate the magnitude of the electromotive force which the generator must develope if a work of p metre-kilos per second must be furnished on a railway of 1 kilometre in length.

For an electric railway on which the recipient is to perform as much work as a 300 horse power steam locomotive on an ordinary line.

$$p = 300 \times 75 = 15^2 \,.\, 10^2 \text{ kilogrammetres,}$$

the generator of an electric railway would consequently have to furnish the electromotive force of

$$\text{E} = 1500 \sqrt{4} = 3000 \text{ volts.}$$

We see, therefore, that for carrying on an electric line of only 4 kilometres in length there would be required an electromotive force of $1500 \sqrt{4} = 3000$ volts—an amount which could scarcely be legally permissible.

If we assume that an electromotive force of 500 volts is the admissible maximum, since currents of higher power are dangerous and difficult to insulate, we should require for working a line 4 kilometres in length at least $\frac{3000}{500} = 6$ generators and as many recipients, or 12 machines, which could not be economical.

This is the reason why the electric lines as yet in existence, which, moreover, cannot be compared with the capabilities of an ordinary line, are extremely short, as appears from the table.

Name of line.	Length in kilo-metres.	Gradient in mm. per kilo-metre.	Speed in metres per second.	Current in ampères.	Resist-ance in ohms.	Electro-motive force in volts.
Mödling, Brühl...	1·5	15	5·5	40	0·7	350
Lichterfelde	7·0	—	5·5	—	—	90
Benthen	0·8	—	4	37	1·6	1000
Portrush	10·0	25	3·1	—	1·5	500

But even on such short lines the electric system has the defect that the steam engine which drives the generator makes 100 revolutions per minute, but the generator 1,600, and that the velocity of the recipient which makes 1,400 revolutions must be transferred to the wheels of the locomotive in such a proportion that they turn only 200 times per minute.

From the steam engine to the generator we have consequently an increase of speed of 1 : 16, and again from the recipient to the wheel of the carriage a decrease of 1 : 7, which certainly does not tend to simplify the machinery.

On considering what has been said, we are driven to the conclusion that on the one hand the weight of the accumulators, and on the other the difficulty of insulating the coils in the dynamos are limits which at present do not permit the advantageous application of electricity as a motive power on railways with a considerable traffic.—*Zeitschrift für Elektrotechnik*.

SOLID v. LAMINATED ARMATURES.

CONTRADICTORY statements have appeared in several publications devoted to electrical matters as to the relative efficiency of solid and laminated armatures. In manufacture, a laminated armature is certainly more expensive, hence it must present some decided advantage over the solid form to ensure its adoption.

In order to decide the point by actual experiment, Mr. Bottone writes to the *English Mechanic* that he fitted up a small dynamo (one of those described in his book) with 7 lbs. of No. 16 c.c. copper wire on the fields. Two armatures, each 1½ in. in diameter, 3¾ in. in length, with a channel ⅞ in. wide, and a web ¼ in. in thickness—one, *a*, solid, weighing 13 oz., the other, *b*, laminated, weighing 11 oz.—were each wound with 6 oz. of No. 20 silk-covered wire, and then soaked in melted paraffin to insure good insulation. These were both mounted on spindles of the same size, fitted with similar commutators, and, in point of fact, rendered as identical as it was possible for them to be except in the point of lamination.

When the solid armature, *a*, was fitted to the dynamo, worked as a series machine, it was possible, by driving at a speed of about 3,000 revolutions per minute, to light fairly well four five-candle Swan lamps, arranged in parallel arc, having each a resistance of 8 ohms. At this speed the electromotive force was about 10 volts at the terminals.

The laminated armature, *b*, was now substituted, and on trial it was found that the five-candle Swan lamps could be kept brilliantly lighted by a speed of 2,000 revolutions per minute. On adding lamps, and increasing the speed, it was found that six and even seven fives could be lighted up, and at 3,000 revolutions the effect with six was as good as the solid armature gave with four. The electromotive force of this machine at this speed was found on careful measurement to be about 20 volts; and, in point of fact, it was possible to light well three ten-candle Swans in parallel arc each of 20 ohms resistance. With regard to heating, *a* rose from a temperature of 45° Fahr. to 120° after a twenty minutes run; *b* after running twenty minutes had only increased 5°.

In order to render the experiments more conclusive, two exactly similar motors were fitted up, alike at all points except in the armatures. The armatures *a* and *b* were fitted to these motors, but so as to be interchangeable at will. No material difference was, however, detected in the field-magnets. These two motors were connected up in series, but back to front, so as to get the driving-wheels to run in opposite directions. The two driving-wheels were then joined together by an endless band, and the motors joined to one and the same battery (so that the same current circulated round both at the same time).

The result was that the motor fitted with the laminated, *b*, armature began to revolve, dragging with it armature *a*, which was thus obliged to rotate in a direction opposite to that in which it was impelled by its own field-magnets.

To what may this superiority be attributed? Probably three causes are at work simultaneously.

1. The sheet iron from which the laminated armature was made is softer, more free from carbon, and purer than it is possible for cast iron to be; hence more rapid and more perfect magnetisation and demagnetisation.

2. The lamination, and consequent separation of the portions of the armature, prevents the formation of the Foucault currents; therefore, the iron cone does not get heated.

3. The interstices between the laminations, by allowing the passage of air, help to keep the armature cool; and the coolness of the armature favours the conductivity of the wire, and consequently the efficiency of the machine.

A MODERN PLATING PLANT, WITH HINTS FOR MANUFACTURERS.

[A COMMUNICATION.]

A VISIT to the works of Messrs. Paterson and Cooper, at Pownall Road, Dalston, London, has revealed so much of interest and value to the various branches of engineering which this journal represents as to induce your correspondent to acquaint the readers of the ELECTRICAL REVIEW with the details.

Electro-metallurgy is as yet in its infancy, but it is a science which engineers cannot afford to despise if they wish to maintain their trade supremacy, as it offers advantages hitherto not fully appreciated. American, German and French engineers have adopted it, and are reaping a rich reward to the disadvantage of British manufacturers. At the above works a regular deposit of pure nickel can be deposited on any metal, so that cylinder covers, engine fittings and ship fittings are at once beautified, and at the same time rendered less liable to rust and tarnish, besides saving labour, and in the engine room saving what is of more value, viz., the use of emery, thus preventing the dust entering the bearings and grinding these away, and often doing serious damage by heating. For cabin and saloon fittings pure nickel is largely used. For fliers in the textile trades it is also much appreciated, also for locomotive domes and safety valve covers. But that which is particularly interesting is the deposition of copper. Hydraulic rams can here be coated with a firm, adhesive deposit of perfectly pure copper up to half an inch (or more) in thickness at a cost of only a few shillings per pound of copper deposited. Plungers and cylinders may also be so treated, whilst for rollers for paper mills, grain mills, and for the textile trades, the process is simply invaluable. Locomotive tubes and condenser tubes claim attention, but what more especially was pointed out was the great value of Messrs. Paterson and Cooper's special process for depositing *any* required thickness of *pure* copper upon ships' propellers, plungers and shafts, and the outside of ships' plates at a reasonable cost, thus effectually rendering a ship proof against barnacles and corrosion from the sea water. This alone opens a vast field for the enterprising firm which has first introduced it to engineers and shipbuilders, and it remains to be seen whether these will be slow to adopt the process. It would be difficult to find space for all the purposes to which this can be applied, but British engineers and shipbuilders have sufficient skill and enterprise to detect its uses and to as readily lay hold of the help which this firm will be willing to render. I may, however, mention one thing where it will be largely used, viz., for "bushing" purposes, as any required thickness of copper can be deposited in a regular form, and one cannot conceive anything so valuable as a coating for boiler plates.

Then for electrotyping. This opens up a field of almost limitless extent. For reproducing statuary, or name plates in large quantities, for multiplying models of the "old masters" or copying the modern art productions, for the highest artistic works, or such simple things as name plates, where large numbers are required, here is a process which accomplishes everything at half the cost of engraving. The potter can now have his moulds more "sharply" cut than by any engraver, and leather embossers their patterns reproduced *ad libitum*, whilst map makers, and a host of others, are offered its numerous advantages.

At the works under notice there are baths and every necessary appliance for the electro deposition of gold, silver, nickel, copper, brass and tin, forming altogether a most complete plant, and Messrs. Paterson and Cooper are prepared not only to plate with these metals for any firm, but to lay down such plant for anyone in any part of the United Kingdom, the continent, colonies, or India, and to thoroughly instruct firms who buy their plant in all the "trade secrets," and will guarantee its thorough efficiency. They also make a speciality of dynamos for copper refining, also gold, silver, and lead refining, and the extraction of metals from their ores. The electrolysis treatment of metals forms a special feature, and it is probable I may return to this in a future article, with the courtesy of the firm who are doing so much to advance and perfect this process, which is likely to revolutionise the old systems to the great pecuniary advantage of the firms who may adopt it. Messrs. Paterson and Cooper, who are well known as large manufacturers of electric light apparatus, their "Phœnix" dynamos being in use in various works, mills, steamships, private houses and hotels, are manufacturing special dynamos for depositing up to nearly 60 cwt. (3 tons) of refined copper per week each—a quantity probably unequalled by any other dynamo in the market. But to this I hope to refer at some future time.

As already mentioned, tin is electrically deposited here. By the process tin plate manufacturers will be enabled to produce tin plates with any thickness of tin upon the "blade" sheets, showing, when finished, a perfectly regular surface at a comparatively small cost as against the "old system," and the various firms will no doubt lay hold of this new process. Pure lead may also be deposited, and this will cause lead to be very largely utilised in many departments hitherto closed, the material being rendered chemically pure.

Hollow-ware manufacturers will thoroughly appreciate the processes now presented to them, as chemically pure copper, tin, and lead can be obtained.

Having thus sketched the various metals which the firm are capable of treating, we may add that not only are they laying down suitable plant for depositing such metals at manufacturers' own works, but are also prepared to supply and fix for any manufacturer their most approved polishing lathes and plant for getting up metals of any kind to the highest possible polish.

The plating shop has a cemented floor, with a suitable fall to take off the waste water. It contains one of the "Phœnix" plating dynamos, made by the firm in their engine shops adjoining, and which works with perfect ease and most successfully six large plating baths containing, respectively, gold, silver, copper, nickel, brass and tin, the dimensions of the nickel and copper baths being about 14 ft. long by 3 ft. wide by 3 ft. deep. Resistance coils of the firm's own make are attached to each bath, so that a thimble can be as easily plated as a bath full of work. Measurements or "tests" of the dynamo and its work are taken by their patent ammeters and voltmeters, and therefore these "records" should enlighten us upon many disputed points which have too often been left to the "rule of thumb," even by firms who should have aspired to a higher standard.

Potash baths with hot potash are used to take off the grease before plating, and hot water tanks are used to immerse the articles in after plating. Both these and a sawdust box or iron cylinder are heated by a steam pipe from the boiler. The whole arrangements and connections are upon the most approved principle. A scratch lathe, fitted with suitable circular brushes of brass, fibre, and German silver, materially assists the cleaning operations; and as cleanliness is the *first* thing to be learnt in plating, its value cannot be overestimated.

The articles before coming into the plating shop are operated upon in the polishing shop above, where the highest lustre and polish obtainable by any process is received. Buffs, brushes, and dollies perform wonders in the hands of these skilful workmen (the polishers and finishers) with their useful machines. German silver goods, brass work, copper work, tin, or the roughest iron work, are here changed in appearance to represent the finest surfaces of the smoothest mirrors.

Such is a sketch of works designed as a model from which Messrs. Paterson and Cooper are ready to lay down similar polishing or plating plant for any manufacturers or other firms, or to fit up plant for the refining of any metals, such as copper, lead, gold, silver, &c., or for tin plate makers, wire manufacturers, and others, or to supply their powerful "Phœnix" dynamos either for plating or the electrolysis process.

ON A PECULIAR BEHAVIOUR OF GLOW LAMPS WHEN RAISED TO HIGH INCANDESCENCE.*

By WILLIAM HENRY PREECE, F.R.S.

1. During my recent visit to America (October, 1884) Mr. Edison showed me a very striking experiment with glow lamps, the principle of which he had not threshed out, although he had

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* From Proceedings of Royal Society, March, 1885.

attempted to apply it practically to the regulation of the current flowing in electric light circuits.

If *a b c* be the incandescent filament of a glow lamp, *d e* a thin narrow platinum plate fixed between the limbs of the filament with an independent wire connection, *e e'*, sealed in the glass globe, then, if a galvanometer, G, be connected between *a*, the positive electrode, and *e*, a derived current will be observed to pass through G, and through the rarefied space, *e c*, when the main current is increased to a certain strength, and the filament reaches a certain degree of incandescence. The strength of this derived current will increase with the increased brilliancy of the glowing filament. Mr. Edison made for me several lamps of different forms and character to enable me to investigate the phenomenon more carefully in England, and I have the pleasure of submitting the results of those experiments to the Society.

2. I used 60 Faure-Sellon-Volckmar cells freshly and fully charged up at each series of experiments. The current through the filament was measured by a specially constituted and calibrated Ayrton and Perry direct-reading spring ammeter. The galvanometer in the shunt circuit was a sensitive tangent galvanometer of the Post Office pattern. The current through the filament was regulated by varying the number of cells. The current and electromotive force through the shunt, *a e*, were calculated by the following method:—The resistance of the galvanometer, G, was 1,070 ohms, and a variable resistance, R, was inserted in its circuit. When the current from a standard Daniell cell (1·07 volt) is sent through the galvanometer, we get a tangent reading, *d*, which, since $\frac{1·07}{1070} = ·001$, is the deflection, or tangent reading corresponding to 1 milliampère of current. The deflection, d_1, given by the shunt current was first read without any resistance being inserted.

Hence

$$c = \frac{d_1}{d} \text{ milliampères.}$$

Resistance was then added and a second reading, d_2, taken; then the resistance, *r*, of the shunt is obtained from the formula

$$r = R \cdot \frac{d_2}{d_1 - d_2} - G.$$

The electromotive force producing the current is

$$E = C\,r.$$

The shunt circuit includes the rarefied space, *e c*, and it is the resistance of this space that we desire to know.

All the observations were simultaneously made by different observers. While one observed the behaviour of the lamp, another read the current flowing through the filament, a third read the currents in the shunt, a fourth varied the electromotive force, and a fifth recorded the results. The electromotive force of the cells was carefully measured before and after the experiments. No photometric measurements were attempted.

3. *Experiment* 1.—The connections were made as shown in fig. 1. The lamp (No. 4) was a short (75 mm.) filament lamp, with a platinum plate 30 mm. long and 5 mm. broad.

EXPERIMENT 1.

Filament.			Shunt.			Remarks.
Volts.	Ampères.	Calculated resistance (hot).	Calculated E.M.F.	Current in milliampères.	Resistance.	
		ohms.	volts.			
44·40	0·7	63·4				
46·62	0·75	62·17	...	...	...	Normal incandescence, viz. 8 candles.
48·84	0·81	60·30				
51·06	0·86	59·37				
53·28	0·91	58·55	14·7	0·30	49,000	
55·50	0·97	57·21	...	...	...	Diffused blue effect in globe appeared.
57·72	1·02	56·60	16·6	1·15	14,500	
59·94	1·08	55·50	16·2	1·80	9,000	
62·16	1·13	55·01	13·5	2·70	5,000	
64·38	1·20	53·66	11·95	3·85	3,000	
66·60	1·24	53·71	7·45	5·25	1,400	Blue effect brilliant.
68·82	1·24	55·51	10·00	5·00	2,000	
71·04	1·30	54·65	9·10	6·00	1,300	
73·26	1·35	54·28	6·50	5·00	1,300	
75·48	1·35	55·92	9·35	5·50	1,700	
77·70	1·41	55·12	9·60	6·00	1,600	
79·92	1·47	54·38	9·80	7·00	1,400	
82·14	1·60	51·34	criti	cal poi	nt	Deflection too unsteady for observation. Blue effect very brilliant.
84·36	1·60	52·74				
86·58	1·53	56·59				
88·80	1·56	57·00	50·6	2·20	23,000	
91·02	1·53	59·30	62·5	2·50	25,000	
93·24	1·57	59·40	61·0	3·20	19,000	
95·46	1·60	59·51	95·0	3·80	25,000	
97·68	...	...	...	...	...	Filament broke. Interior of globe and faces of plate blackened.

The variation of the current and the increase in the resistance of the filament towards the end of the experiment, together with the behaviour of the shunt, are very noticeable. It is quite clear that when the electromotive force attained 82 volts, a critical point was reached. From that point the current in the filament remained very steady, but the resistance gradually increased. The shunt increased in resistance enormously, and the current through it diminished, although the electromotive force increased very largely. It is remarkable how steady the electromotive force in the shunt remained until the critical point was reached, when it suddenly increased and only reached that of the main current at the point of rupture of the filament. Again the current, which steadily increased until the critical point was reached, then diminished, indicating a considerable increase in the resistance of the rarefied space, *e c*. In one subsequent experiment, after the critical point was reached, no current could be obtained through the shunt.

The direction of the current is shown in the figure.

Towards the end of the experiment, when the characteristic diffused blue effect in the globe was very marked, a bright arc was observed to be playing about the bottom of the limb at *c*, and it was quite clear that a bridge of conducting material was formed between *e* and *c*, which, together with the galvanometer, made a shunt to the filament.

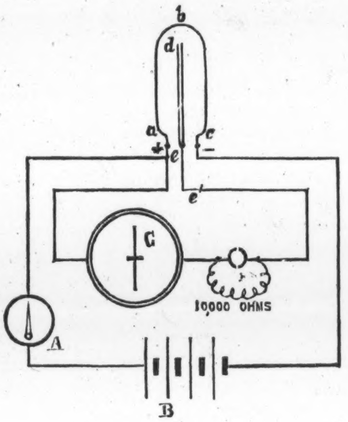

FIG. 1.

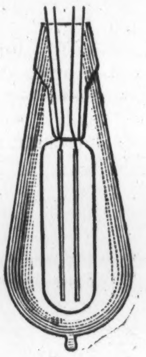

FIG. 2.

This experiment was repeated upon different lamps, and the results were so similar that it is not necessary to reproduce the observations.

In all cases an intimate connection was observed between the blue effect and the appearance of the shunt current.

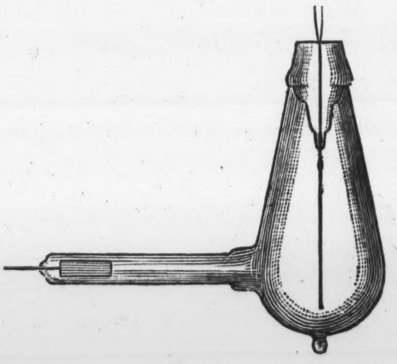

FIG. 3.

4. One of Mr. Edison's assistants showed me in Philadelphia that while the effect was very perceptible when the connections were made as shown in fig. 1, *a* being in connection with the positive and *e* with the negative pole, no shunt current or a very slight one could be observed when the direction of the current was reversed. I did not find this invariably the case. One lamp (No. 8) only—a long filament lamp (150 mm. long)—which gave a marked shunt current and the blue effect, when the connections were made as in fig. 1, failed to give any current or blue effect when the current was reversed within the limits of the electromotive force at my command. Doubtless I should have got both effects if I could have raised the electromotive force. In all cases, however, the effects appeared sooner and were more marked when the connections were as shown in fig. 1 than when the direction of the current was reversed. The effect of placing the galvanometer between *e* and *c* was the same as reversing the current.

5. As the effect might be due in some way to the material of the conducting plate, *d e*, inserted between the limbs of the

filament, Mr. Edison made for me lamps with copper, iron, and carbon plates.

The following experiments were then made, the connections being the same as fig. 1 :—

EXPERIMENT 2.—CARBON CENTRE (SINGLE).

Filament.			Shunt.			Remarks.
Volts.	Ampères.	Calculated resistance (hot).	Calculated E.M.F.	Current in milliampères	Resistance.	
		ohms.	volts.			
80	0·50	160·0				
84	·57	147·4	...	0·98		
88	·60	146·7	5·44	0·54	99,000	
92	·65	141·6	4·76	1·22	39,000	
96	·70	137·1	27·7	2·20	12,600	
100	·74	135·1	25·4	3·42	7,420	Blue tinge appeared.
104	·79	131·7	21·4	4·88	4,380	
108	·83	130·1	17·5	7·32	2,390	
88	0·60	146·7	08·23	0·46	179,000	Reversed the current through the filament and repeated the experiments.
92	·65	141·6	04·86	0·93	52,300	
96	·70	137·1	26·0	1·76	14,800	
100	·74	135·1	21·1	2·93	7,190	Blue tinge appeared.
104	·79	131·7	19·1	4·45	4,300	
108	·83	130·1	17·5	7·32	2,390	

EXPERIMENT 3.—IRON CENTRE (SINGLE).

Filament.			Shunt.			Remarks.
Volts.	Ampères.	Calculated resistance (hot).	Calculated E.M.F.	Current in milliampères	Resistance.	
		ohms.	volts.			
80	0·50	160·0				
90	·57	157·9				
96	·62	154·8	...	0·25		
100	·66	151·5	...	0·49		
110	·77	142·9	31·4	2·05	15,300	
120	·87	137·9	19·8	5·85	3,380	Faint Blue.
90	0·57	157·9	...	0·09	...	Reversed the current through the filament and repeated the experiments
100	·66	151·5	...	0·49		
110	·77	142·9	27·3	1·95	14,000	
120	·87	137·9	20 0	5·61	3,560	Faint blue.

EXPERIMENT 4.—COPPER CENTRE (SINGLE).

Filament.			Shunt.			Remarks.
Volts.	Ampères.	Calculated resistance (hot).	Calcu. E.M.F.	Current in milliampères	Resistance.	
		ohms.	volts.			
80	0·57	140·4	...	0·048		
90	·67	134·3	39·2	1·12	35,000	
100	·79	126·6	19·0	3·80	5,000	Faint blue.
110	·90	122·2	...	needle hard over	...	Strong blue.
90	0·67	134·3	29·9	0·88	34,000	Reversed the current through the filament and repeated the experiments.
100	·79	126·6	17·2	3·32	5,190	Faint blue.
110	·90	122·2	...	needle hard over	...	Strong blue.

No marked difference was thus observable.

If we examine the shunt current when the faint blue tinge appeared, it was: with carbon, 3·42; with iron, 5·85; and with copper, 3·80 milliampères.

6. It might be affected by the extent of surface of the metal plate, therefore lamps were made with a plate of fine wire, and also of a very broad surface, but no difference was observable between these and the normal plate used.

7. Lamp No. 9 was made with a double platinum plate, as shown in fig. 2.

The following experiment shows that no perceptible difference was observable :—

EXPERIMENT 5.—NO. 9 LAMP (DOUBLE PLATINUM).

Filament.			Shunt.					
Volts.	Ampères.	Calculated resistance (hot)	Calculated E.M.F.		Current in milliampères.		Ohms.	
			Left.	Right.	Left.	Right.	Left.	Right.
		ohms.	volts.	volts.				
80	0·56	142·9	5·46	5·46	0·39	0·39	140,000	140,000
84	·60	140·0	3·8	3·8	0·83	0·83	45,700	45,700
88	·65	135·4	24·5	24·5	1·56	1·56	15,700	15,700
90	·68	132·4	20·5	20·5	2·05	2·05	10,000	10,000
94	·72	130·6	16·2	16·2	3·27	3·27	4,950	4,950
100	·79	126·6	15·4	15·4	5·85	5·85	2,630	2,630*
110	·92	119·6			Doubt	ful.		

* Slight blue tinge perceptible.

8. Although the maximum effect was produced by Mr. Edison when the plate was fixed between the limbs, he obtained a current when it was fixed in any part of the rarefied space. If the effect was due primarily to the Crookes effect, or to the projection of molecules from the carbon filament on to the metal plate, since this bombardment takes place in right lines, we ought to have obtained effects when these lines were projected on the plate, but no effects when they could not strike the plate. Several lamps were made, which are shown in the following sketches.

9. The metal plate was taken from between the limbs of the filament, and placed at the end of a tube which had a portion of the filament exposed to the plate.

EXPERIMENT 6.—NO. 5 LAMP.

Filament.			Shunt.			Remarks.
Volts.	Ampères.	Calculated resistance (hot).	Calculated E.M.F.	Current in milliampères	Ohms.	
		ohms.	volts.			
50	...	...	...	...	...	a +, c —, fig. 1.
60						
70	0·55	127·3				
80	0·65	123·1				
84	0·70	120·0				
86	0·73	117·8				
88	0·75	117·3				
90	0·77	116·9				
92	0·80	115·0				
94	0·82	114·6				
96	0·85	113·0		No current		
98	0·87	112·6	...	...	...	Blue effect visible in bulb.
100	0·89	112·4				
102	0·93	109·7				
104	0·96	108·3				
106	0·99	107·1	...	...	...	Blue effect strong in bulb; none in tube.
108	1·01	106·9				
110	1·05	104·7				

Reversed the current through the filament. Returned to 90 volts, and repeated the experiments. Filament current readings the same as before, and also the blue effects. At 108 volts a slight blue effect was noticed in the open end of the tube.

RECOMMENCED EXPERIMENT WITH 100 VOLTS.

Filament.			Shunt.			Remarks.
Volts.	Ampères.	Calculated resistance (hot).	Calculated E.M.F.	Current in milliampères	Ohms.	
		ohms.	volts.			
100	0·89	112·4	...	...	...	a +, c —, fig. 1.
102	0·93	109·7				
104	0·96	108·3	...	·049		
106	0·99	107·1	...	·049		
108	1·01	106·9	...	...	...	Blue effect entering tube.
110	1·05	104·7	...	·073		
112	1·07	104·7	...	·146		
114	1·11	102·7	...	·195		
116	1·14	101·8	...	·24		
118	1·18	100·0	11·3	·39	29,000?	Deflection too low to enable resistance to be properly measured.
120	1·22	98·36	10·9	·49	22,300	

Doubtless, if I could have increased the electromotive force, the results would have been more marked; but they were sufficient to show that the effects were evident, even though the rarefied space were greatly extended, as in the case of the tube attached to No. 5 lamp.

10. The tube was constructed so that no portion of the filament was opposed by right lines to the metal plate (fig. 4).

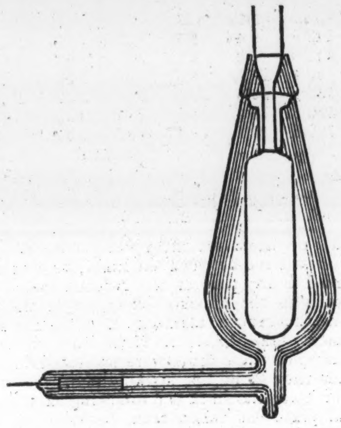

Fig. 4.

EXPERIMENT 7.—NO. 6 LAMP (LONG FILAMENT).

Filament.			Shunt.			Remarks.
Volts.	Ampères.	Calculated resistance (hot).	Calculated E.M.F.	Current in milliampères	Ohms.	
		ohms.				
76						
80	0·57	140·3				
84	0·60	140·0				
88	0·65	135·4				
92	0·71	129·6				
96	0·75	128·0				
100	0·80	125·0	...	...	...	Faint blue in globe.
104	0·84	123·8	...	·049	Deflections too low to enable resistance to be measured.	
108	0·89	121·3	...	·085		
112	0·94	119·1	...	·10		Blue in globe very marked.
116	0·99	117·2	...	·073		
120	1·06	113·2	...	·20		Bulb hot, tube cool.

11. A lamp was constructed with three branches at right angles to each other, as shown in fig. 5, and each metal plate taken in succession, but no results were obtained.

EXPERIMENT 8.—NO. 7 LAMP.

Filament.			Shunt.			Remarks.
Volts.	Ampères.	Calculated resistance (hot).	Calculated E.M.F.	Current in milliampères	Ohms.	
		ohms.				
80	0·56	142·9				
90	0·66	136·4				
100	0·77	129·9	...	...	...	Blue effect in globe visible.
102	0·79	129·1		No current evident in either section.		
104	0·82	126·8				
106	0·84	126·2				
108	0·86	125·6				
110	0·89	123·6				
112	0·91	123·1				
114	0·94	121·3				
116	0·98	118·4				
118	1·00	118·0				
120	1·02	117·7				

12. Professors Liveing and Dewar ("Proc. Roy. Soc.," March 9, 1882), observed a "sort of flame" during high incandescence, showing by its spectrum the presence of carbonic oxide. It was strongest about the junction of the carbon thread and the positive electrode. It was, according to them, the glow of the positive pole attending a discharge in rarefied gas.

It is a common thing with glow-lamps which have the heels of the filament close together to have an arc forming across when the electromotive force at the terminals is too high. Hence in recent lamps requiring 100 volts, Mr. Swan has considerably increased the distance between the electrodes. Moreover, whenever the incandescence of the filament is raised beyond a certain limit the interior of the glass envelope is blackened by a layer of carbon, which has been deposited by a Crookes bombardment effect. When the carbon filament is fixed on copper electrodes, the interior of the glass sometimes becomes coated with copper as well as with carbon, and the line between the two is perfectly marked, showing that the bombardment takes place in right lines. Experiment 1 shows how very high the electromotive force can be carried, if it be steadily and rapidly increased, before the filament is broken; but practice shows that when once the blue effect appears, destruction is only a question of time. Hence the blue effect is an indication of the advent of disintegration, and a very useful warning of danger ahead.

13. Now it is clear that we have a combination of the phenomena above described in the Edison effect. A continuous bridge of molecules is formed between the junction of the carbon filament, and the metal plates inserted between its heels. They are found deposited on the metal plate. A shunt is thus formed whose resistance is measurable, and a definite current passes. This shunt is formed just where the negative metallic connection joins the heel of the carbon filament, as we should expect from the investigations of Mr. Crookes. The current is, however, weak and variable, and it is scarcely reliable enough to be useful for practical purposes as was hoped by its discoverer. When the critical point is reached the blue glow and flame seem to pervade the whole bulb, and the arc-like effect, instead of playing about the heel, surrounds apparently the whole filament. The result is that the current passes through the galvanometer and through the rarefied space. This is clearly shown in Experiment 1.

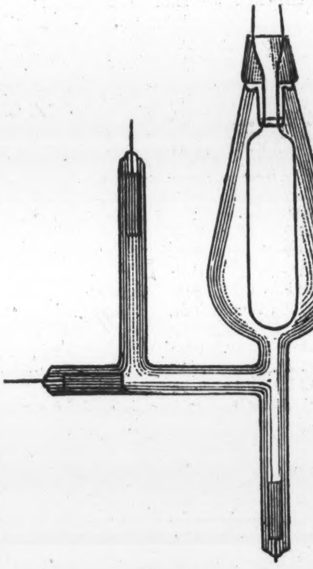

Fig. 5.

14. It is quite clear that the critical point is reached when the filament commences to be disintegrated by the projection of its molecules from its surface. It is here that the resistance of the filament commences to increase, and the law of radiation and light emission ("Proc. Roy. Soc.," No. 229, 1884) commences to be departed from, as was shown by me in a paper read before the British Association at the Montreal meeting.*

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* In this paper I pointed out from experimental data that the light emitted by a glow-lamp varied apparently as the sixth power of the current. I verified this law, not only by subsequent experiments of my own, but, which is much more satisfactory, by experiments of others. Professor Kittler, of Darmstadt, and Captain Abney made, independently of each other, most careful and exhaustive measurements in this direction. I tabulated and traced them out in curves. They fully confirm the law that

$$L = k\,C^6,$$

but within limits, and that these limits embrace the ordinary range of a glow-lamp when used for artificial illumination. As long as the resistance and the current vary uniformly together the law holds good; but as the state of incandescence is increased, a point is reached, varying with each kind of lamp, when the resistance ceases to diminish at the same rate, and eventually to increase. When this occurs the law is departed from, and the light emitted increases much faster than the sixth power of the current. The filament speedily breaks. The point of departure from the law indicates a point when a change of state occurs in the carbon filament. Disintegration probably sets in. This point ought to be determined for each kind of lamp, and it should never be allowed to be reached, for it is from this point that decay commences and rupture follows.

15. It is very evident that this Edison effect is due to the formation of an arc between the carbon filament and the metal plate fixed in the vacuous bulb; that this arc is due to the projection of the carbon particles in right lines across the vacuous space; and that it makes its appearance earlier, and is more strongly marked, when the connexions are as shown in fig. 1 than when they are reversed, because, as Mr. Crookes has pointed out, the projection proceeds from the negative to the positive pole, and it would commence at the point of least resistance. Its presence is detrimental to the life of the lamp, and as its appearance is contemporaneous with the blue effect, the latter is a warning of the approach of the critical point, and a sure indication that the electromotive force is dangerously high. It is also clear that as the Edison effect is only evident when we are "among the breakers," it is not available for practically regulating the conditions of electric light currents as its ingenious discoverer originally proposed.

ELECTRIC LIGHTING FOR STEAMSHIPS.*

By ANDREW JAMIESON, Assoc. M. Inst. C.E. and F.R.S.E.

DISCUSSION.

(*Continued from page* 286.)

Mr. G. B. Oughterson said that the author had stated, in reference to direct driving dynamos: "Besides these objections, direct driving of the dynamo armature from the crank shaft of a fast speed engine is very popular, and such engines cannot be relied on at speeds of over 600 revolutions per minute for any lengthened period." A table issued by Messrs. Sautter, Lemonnier and Co., at the Vienna Exhibition in 1883, contained instances of 276 applications of Brotherhood's direct driving engines to dynamos, 236 of which were driven at speeds over that given in the paper as a maximum, and out of the 236 there were 106 working at 1,600 revolutions a minute. Amongst the applications made for electric lighting of steamships, there were a great number of direct driving engines attaining speeds much above 600 revolutions. In the case of the *Himalaya*, the engines ran at 650 revolutions. The electric lighting engines at the Royal Laboratory at Woolwich, driving 16-light Brush dynamos, and indicating 20 H.P., ran at 850 revolutions. He might also mention the case of two 6-inch engines, working with 70 lbs. steam pressure, and each driving a 16-light Brush dynamo at 850 revolutions per minute, that had been running 18 months consecutively, on an average 11 hours a day, without needing any repairs. With reference to governors, the author had laid down the law that no mechanical governor would "keep the engine within 5 per cent. of its normal speed, with a load varying 90 per cent., and a boiler pressure varying 10 lbs. per square inch." In some experiments that he had made with a Brotherhood direct driving engine, the engine had to run, to give out its maximum power, with a steam pressure of 40 lbs. It was started with that pressure at the boiler, and the governor was set for a speed of 600 revolutions per minute. The pressure was allowed to rise in the boiler from 40 lbs. to 75 lbs., without any increase in the speed of the engine. The arc light was suddenly extinguished, and the rise of speed at the instant of extinction was only 20 revolutions above the normal, and then the speed settled to the normal in two seconds. That showed that a mechanical governor could at any rate do what the author had said it could not accomplish. He should like to say a few words about the flexible coupling and might mention that Brotherhood's patent flexible coupling, had been put up exactly twelve months ago, to drive the line shafting at the works of Messss. Simpson and Co., and the leather had been withdrawn for exhibition at this meeting. It had been running regularly at a speed of 80 revolutions, carrying 40 H.P., and it had made in all about 15,000,000 revolutions. During this time it had driven 23 lathes, three planing machines, a circular saw, and some woodworking machinery. The leather would be found on inspection to have stood the immense strain remarkably well. He had had considerable experience with this system of coupling, and he thought that for ship lighting some coupling of that nature ought always to be interposed between the engine and the dynamo, so as to relieve the bearings should irregular wear take place.

Mr. W. M. Mordey observed that the sensitiveness of the author's electric governor must depend largely upon the ease with which the currents could be generated in the revolving copper disc. The resistance of copper varied considerably with temperature. The rise in the resistance of pure copper was 0·388 per cent. per degree Centigrade, so that as the temperature increased from the action of the Foucault or eddy currents generated, as well as by the ordinary changes of temperature, the resistance would rise considerably. As at a given speed and in a given field the currents would be inversely as the resistance, it followed that a rise of 10° Centigrade would mean a fall in the eddy currents of about 4 per cent.; and a rise of 25° Centigrade, which was not too great a rise to imagine as taking place, partly from the action of the current in the disc, and partly from ordinary causes, would mean a loss of sensitiveness in the governor of about 10 per cent. He wished to ask the author whether it had been necessary to use any sort of temperature correction on account of that supposed fault, or whether the fault existed? A good deal had been said about the question of low speed dynamos on board ship. He was well acquainted with some dynamos—and he believed it was the case with all good dynamos—in which the speed could be reduced considerably without any appreciable increase either in size or weight. He was acquainted with one dynamo, of a pretty well-known type, supplied to run at a reduction of 25 per cent. on the very moderate normal speed and to do full work, without any appreciable increase in size or weight, and without any other loss, or without any circumstance that would tend to render low speed driving in such a case objectionable.

The author had referred to the important point of the insulation of the conductors of dynamos, but he had said nothing about another point of equal importance, though often overlooked, viz., the insulation between the iron frame of the machine and the earth, or the metal of the ship, as the case might be. The insulation resistance between the conductor of the dynamo and its frame must necessarily be rather low when the machine got hot, for the simple reason that the resistance of dielectrics followed an exactly opposite law to that of metals, becoming much lower as the temperature rose. In all dynamos there was more or less heating when the machine had been working a considerable time, therefore the insulation resistance between the conductor and the frame must fall. There were other circumstances also which tended to reduce that insulation resistance, such as the expansion of the conductors, and perhaps the fact that filings or metallic dust from the brushes might lodge. If the insulation resistance between the conductor of the dynamo and the frame were attended to, and also insulation between the frame and the earth, there would be an additional link in the chain of insulation, the breaking of which would be more difficult than when the machine was put on an iron base, and no precaution was taken to prevent earth contact. That was particularly necessary in the single wire system, and less necessary, but still very necessary in the double wire system. Of course there might be one contact between the conductor of the machine and the iron, and it would do no harm if the leads on the circuit were insulated; but if the frame was insulated from earth, a single fault, even if it was a "dead earth" on the external circuit, in addition to the dynamo fault, would do no harm, although very undesirable. It was less difficult to insulate the leads in the external circuit well than it was in the dynamo, because space was not so valuable, and the thickness of the dielectrics might be much greater. Therefore he thought that the insulation resistance of the frame and of the machine should receive as much attention as any other part of the system. Mr. Sellon had spoken of the working of compound dynamo machines in parallel circuit with reference to some observations by Dr. Hopkinson. Of course anything stated by Dr. Hopkinson on the subject of dynamo machines must be received with a great deal of respect; but he agreed with Mr. Sellon as to the practicability and ease of working compound dynamo machines in parallel circuit. In fact, he believed that he had been the first to use, and, as far as he knew, had originated the method sketched by Mr. Sellon. The rationale of the process was simple. If not only the shunt circuits of the machines were parallel, but also the series circuits, it followed in the case of two exactly similar machines that—the loads being always alike when speeds were alike—if the machines were being driven by belts which were not of the same character, or if the pulleys differed a little in size, any tendency of the one to lag would throw more work on the other, slightly pulling it up, and allowing the lagging machine to "race." In that way they exercised a mutually adjusting "power," and would work with the greatest ease, even if considerable liberties were taken with regard to the position of the brushes. And not only would two similar compound dynamos work in parallel circuit; but any number of compound dynamo machines of varying size, power, or speed, would work well in parallel circuit; and each machine would take exactly the proportion of power that it ought to take, and would do exactly the amount of work that should fall to its share. There was only one precaution to be observed in such a case, in addition to that of joining up the machine, so that not only were the brushes parallel, but also the terminals, namely, the resistance of the series circuits of the various dynamos must be inversely proportional to the currents they supplied. In that case, as the fall of potential through the series circuits would always be alike in all the machines, whatever the currents, and whatever size they were, and the current in each individual field-magnet being exactly right, they would work in a perfectly satisfactory way. But that did not cover the whole subject. Further examination would show that the characteristic curves of such dissimilar dynamos ought to have similar formations to exercise that mutual adjusting power with the greatest effect. Still for practical purposes those two precautions were amply sufficient to enable compound dynamo machines to work in parallel circuit. A method of connecting the machines, differing from the above, has been suggested by Dr. Hopkinson. It is very similar to that which, as is well known, has been used for some years with Gramme dynamos, and consists in employing the current of one machine, A, to excite the fields of a second machine, B, while the current of B in turn is made to magnetise the fields of A. This is, of course, a perfectly practicable plan. With compound dynamos the series coils will alone require to be operated in this way. But there are some objections to such an arrangement. It can only be used when the dynamos are exact copies of each other, and is therefore out of the question when it is desired to utilise machines of various sizes and speeds to operate one circuit. Another objection is that with such a method it is always necessary to have at least two machines working, even when one is sufficient, or more than sufficient for the requirements of the moment. In such a case, when it may be desired to use one machine only, an arrangement of switches always more or less unsatisfactory must be adopted; while the making of the involved change could scarcely be affected while the machines were working, without causing some interruption of the external circuit; an event, however momentary, to be carefully avoided in practical work. Again, an accident to one machine would incapacitate not only that machine, but also the second one which relied on the former for its field excitation.

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* From the Proceedings of the Institution of Civil Engineers.

The first plan sketched above of true independent parallel working appears the more satisfactory one, and may be used in a lighting station, or in any situation where the varying requirements of the circuit render it desirable to bring additional machines into operation as the work increases; and to disconnect them from the mains as the demand for current falls off. Another observation made by Dr. Hopkinson related to the amount of correction in compound engines. He could not agree that the smallness of the correction played so important a part as had been imagined. If smallness of correction were necessary for good compounding, it would be impossible to use compound dynamo machines in places where it was necessary to have the machine a considerable distance away from its work, and it would not be possible satisfactorily to compound a dynamo machine, so that it would maintain a constant potential at a distant point of the circuit with a varying load. He might be permitted to state a case, perhaps an exaggerated one, to illustrate his meaning. Let it be imagined, that at some large house or hotel there was a group of lamps—the lamps in the house might in such a case be considered as one group, being within a short distance of one another—and that on account perhaps of the cheapness of power at some distant place it would be economical to work a dynamo, the loss in the leads might be very considerable, and yet there would be no want of economy. A dynamo might be so distant—not in miles or in yards necessarily, but in ohms—that a loss in the leads between the dynamo and its work of 50 per cent. might be permissible. For such a case it would be quite easy to construct a machine so that, with this loss of 50 per cent. in the leads, and varying between the full load and no load, it would maintain a practically constant potential at the terminals of the lamps. Of course such a case would mean that if the lamps required 100 volts the potential would fall from 200 to 100 at the dynamo terminals as the work fell from the full load to nothing. He could find no fault with the curve of the compound-wound Victoria dynamo. He agreed with what Mr. Sellon had stated, that in many large houses and ships, where all the work was near the dynamo, and where the distribution of the lamps was not from a distant part of the circuit, but began almost immediately after the leads left the dynamo, it was unnecessary to have a great fall n the electromotive force. In fact, with such a fall, and only a few lamps lighted, at whatever part of the circuit they might be, those few lamps would be very dull; and it would be necessary to increase the speed of the machine in order to bring the light up to the normal power. He might be permitted to say another word with regard to the curve in question. Although the Brush Electric Light Company had for several years manufactured dynamo machines for maintaining a constant potential at the terminals in electro-plating operations, where a change in the number of articles in the vat was constantly going on, and where, on account of the necessity of obtaining an even deposit on all the articles in the vat, it was necessary to maintain almost a constant potential, yet the making of compound machines was undertaken in the first place on the machine from which that curve was taken. The winding of the machine was calculated by Mr. Watson, who originated the very excellent method of compounding that was used; it was calculated from experiments and put on to the new machine. The machine was run, and at the anticipated speed, without the slightest modification or alteration, it gave the very satisfactory results shown by the curve. That spoke, he thought, very highly for the method. It would be interesting to know what the first curve of the first compound-wound Siemens dynamo was like.

Mr. Charles Friend Cooper said that the details given by Mr. Paxman, with regard to mechanical governors, might almost make engineers regret that they had anything to do with electrical governors. Nevertheless all the mechanical governors with which he was acquainted were actuated by a difference of that which it was desired to keep constant, namely, the speed. In other words the speed of the engine must alter before the throttle-valve (or link of expansion-valve) could act. The speed must alter before the governor could act to regulate that speed. He understood that the author in his electric governor revolved the copper-disc in the field of an electro-magnet, wound as a shunt to the main circuit. This appeared to him liable to the same objection as the mechanical governor, because the electromotive force was dependent upon the speed, and therefore the speed must alter before the electromotive force could alter. He would ask if it was not possible to make a modification of the governor in which the electro-magnet should be wound in main circuit, in which case the strength of field would vary with the current and not with the electromotive force? Now, in a self-regulating dynamo the current was the variable factor, the object of such a machine being to keep the potential constant for all currents, and therefore the most direct governing would be by that variable. In a governor suggested to him by Mr. Esson, fig. 11, consisting of a plain double solenoid wound in main circuit, the pull on the cores due to the current was opposed by a spiral spring, and the cores were connected to a lever attached to the throttle-valve by means of a rod, which might equally well be attached to the link of an expansion valve. The action of this hardly required explanation. When extra lamps were turned on, or more current flowed, the cores of the solenoids were pulled down against the spring and the throttle-valve was opened; if the current was reduced the spring predominated and the valve was closed. He here directed attention to a diagram (fig. 12) of the characteristics of a 300-light self-regulating "Phœnix" dynamo, showing that the current was almost proportional to the watts produced. Diagram fig. 13 showed a modification of the author's governor, which was actuated by variations of the current. The copper disc, D, revolved in a field, M, produced by the main current, and was secured to the boss of one of the three bevel wheels, B, which was loose on the spindle. The spring, Sp, acted in opposition to the turning of the spindle one way, and the wheel itself geared into the centre wheel, C, whose axis was keyed to that spindle. The disc was driven through the centre wheel from the third wheel, A, and pulley, P, which was loose on the shaft. Now when the resistance to the revolution of the disc, D, was increased or diminished (due to more or less current flowing in main current) this centre wheel, C, either rode up or down, and its axis being fastened to the spindle turned it, and thus opened or closed the throttle-valve, T; that was, it regulated the opening of the valve without reference to the electromotive force or speed. He was familiar with this arrangement as applied to a transmission dynamometer. Referring to fig. 14, it would be seen that the characteristics of this machine were practically the same at 1,000 revolutions and at 500 revolutions, as well as at intermediate speeds—the difference of potential being not more than 4 volts out in any case.

Mr. H. F. Joel said it would have been a great advantage to have had the benefit of the author's experience, especially with regard to the failures of electric lighting on board ships. He had

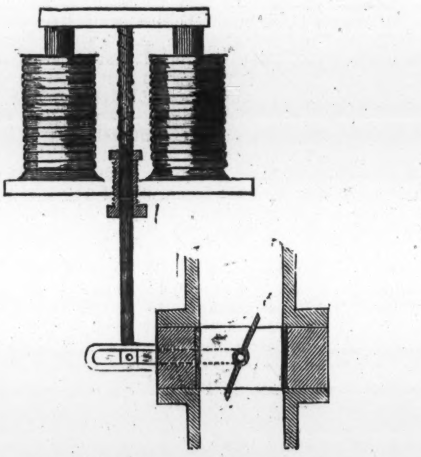


Fig. 11.—Electric Governor.

In compound machines for constant potential coil in the circuit.
For constant current coil in a shunt to terminals.

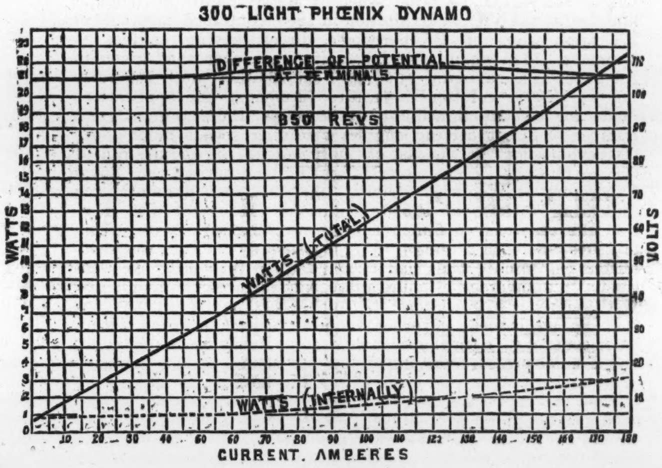


Fig. 12.

The figures to the left represent thousands of watts.

known a failure in an installation, where the dynamo was spoiled by the bursting of a steam pipe close by. The steam saturated the insulation of the dynamo, and the dynamo was started again, and broke down. He had known other cases where the two small wires connecting the lamps had been placed close together, and fixed to the ship's sides under one staple, short-circuiting being the result. As to the question of the double or the single wire system, the former was the only safe system to use; it was easily fitted, but not the latter. Only one reason could be adduced in favour of the single-wire system, namely, the keeping down of the estimate. Mr. Siemens had stated that he had often to go 2 or 3 feet from a single wire through the woodwork to get to the ship's side. But the difficulty did not end here. There was the making of the joints between the insulated wire and the ship's side, and those joints, which were always hidden, were the great drawback. In the double wire system the joints were exposed and they could be so well made as not to fail. If the dynamo broke down, if there was a leak in the insulation, the single wire system offered every facility for complete failure, and great difficulty in localisation of the faults. Mr. Farquharson had pointed out that the two wires being fixed together might be a disadvantage; but by putting them 18 inches apart, or even 10 feet apart, they afforded a perfect system. The danger of the ground circuit increased tenfold on board ship, owing to the difficulty of preserving the insulation, and on that account it should not be permitted. Alternating current machines, in which the currents were much varied in intensity through the alternating action, tried the insulation more than the continuous current system, and on that account they should not be allowed under any circumstances. As the result of considerable experience, he found that accumulators were still very unsatisfactory. With a man to superintend who thoroughly knew how to clean them, they might be used successfully on board ship, because they could be run direct from the main engine. They acted as a governor to keep the lights steady, and in case of a breakdown of the machines, the accumulator would give sufficient power to keep the lights in action; for those reasons they might be useful. The magnetic action of the dynamo machines, and also the action of the electrical currents in the wires on the ship's magnetic compasses, had not yet been referred to. A serious error might possibly arise from either or both of these causes. The influence of the electrical currents in the wires, if they passed within, say, 10 feet of the compasses, would be appreciable, especially when the current was started or stopped, and he would direct the attention of naval officers and engineers to that point. Precautions could easily be taken to prevent any error on this account; first, by maintaining the electric light in full action whilst the ship's compasses were being adjusted, stopping and starting repeatedly during the time, and noting the errors, if any; secondly, by running the double wire system with the two wires nearly together, say 3 inches apart only, so that the currents going and returning would neutralise the action of each other.

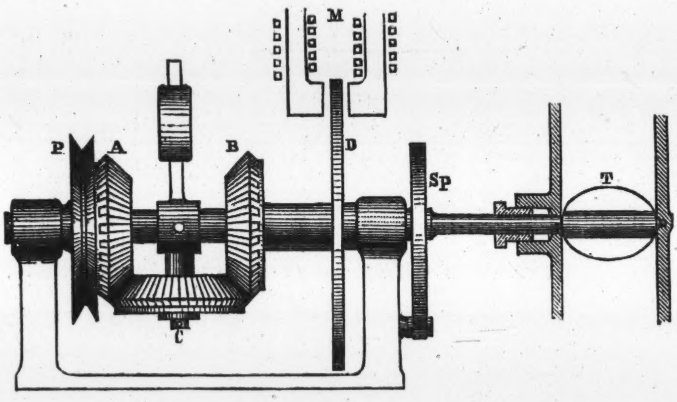


FIG. 13.

MODIFICATION OF JAMIESON'S ELECTRIC GOVERNOR. 1884.

(*To be continued.*)

Cable News.—The cable steamer *Dacia*, belonging to the Silvertown Company, left the river, on the 2nd inst., for Key West, Florida. This vessel is on charter by the International Ocean Telegraph Company of New York, and carries heavy cable for the part renewal of the 1869 cable of this company. The new cable is of a type specially manufactured for resisting the destructive chemical action of the bottom met with in the neighbourhood of Key West.

THE THERMOPHONE OF DR. J. OCHOROWICZ.

AT the last *séance* of the Société Internationale des Electriciens, says the *Journal Telegraphique*, Dr. J. Ochorowicz described and illustrated before the society a new microphonic system which had for its object a sensible increase in the sounds emitted by the telephone. The following are the explanations of the apparatus given by the inventor:—

"The system is composed of two parts:

"The *magnetic receiver*, which differs from all other instruments of the kind—1st, by the employment of two vibrating plates equally polarized by the same magnet, and embracing the two extremities of the coils; 2nd, by the method of attachment of the telephone case, which, instead of being immovable, vibrates in unison, being fixed only by the middle of the second vibrating plate.

"A detailed examination of this arrangement shows the perfect utilisation of the magnetic field and the absolute consonance of the vibrators of the entire system.

"The object of these refinements is the replacement of the ordinary microphones.

"The *thermomicrophone* is the most powerful of all telephonic transmitters. It reproduces the speech of a high-pitched voice, even when spoken to at a distance from the instrument; singing and music, which actuates it at a distance of several metres, can nevertheless be heard at the end of a connecting line all over a large room.

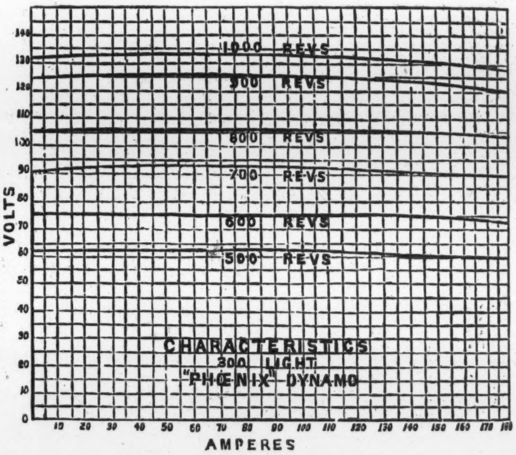


FIG. 14.

"The principle of the apparatus is as follows:

"All known microphones belong to two different classes; the first—the Edison type—includes all transmitters which work by *pressure* (Blake, Righi, Machalski, Walla); the second description—the Hughes type—includes all transmitters which work chiefly by *shaking*, and which always consist of a number of carbons freely poised (Crossley, Ader, Gower-Bell, d'Arsonval, Maiche).

"The thermomicrophone occupies an intermediate place: it works both by shaking and pressure.

"But this is not the chief characteristic of the system. This characteristic consists in the intervention of heat.

"It does not only work by *heat*.

"All microphones in general, and powder microphones in particular, become hot when working: they then work better. But the fact of their heating constitutes a great inconvenience—the heat deranges the apparatus.

"As it is impossible to avoid the heating when loud sounds are required to be produced, it occurred to me that it might be possible to utilize the difficulty by making it act as a regulator. During the action the microphone becomes deranged; its resistance is then almost nothing. But so long as only a current of 18 to 20 milliampères flows, it heats; its resistance increases (it has a mean value of 200 ohms); and the apparatus becomes regulated for transmission. It is evident that under these conditions the external temperature can assist or hinder the good working of the transmitter; but, by the application of an insulating covering in the interior of the microphone itself, I can assure its constancy between 13° and 37°. This is sufficient for practical purposes.

"The heat, then, plays a real part in the working of the instrument, to which I have given the name of *thermomicrophone.*"

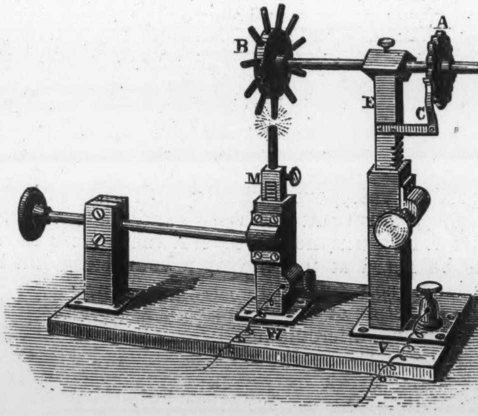
The bulletin of the society, from which we reprint the above description, adds that in the experiments in audition, which illustrated Dr. Ochorowicz's invention, the thermomicrophone was worked by the current from 5 Leclanché elements, and was placed in the library of the Société de Geographie: the receiver was placed on a table in the centre of the Conference Hall on the ground floor.

Under these conditions speech, transmitted through a line about 50 metres long, was very clearly heard at several metres distance from the telephonic receiver: singing was heard clearly all over the room, where 300 members were assembled.

HAND REGULATOR FOR THE ELECTRIC LIGHT EMPLOYED FOR THE PROJECTION OF SHADOWS.

IN the Journal de Chimie Appliquée (says *La Lumière Electrique*), Dr. Walter contributes a communication relative to an apparatus, by the help of which it is possible, without difficulty, to render various substances incandescent for the purpose of spectrum analysis.

It has been usual to employ the Dubosq lamp in such cases.* The introduction of the substances into the cavity at the extremity of the lower carbon is not an easy operation when the arc is formed; the dazzling effect of the light is very troublesome to the experimenter, and consequently often severely tries the patience of the audience. Dr. Walter has constructed the apparatus—of which we give a figure—which acts solely as a hand regulator, so that the exhibition of the shadows does not practically occupy any time. The disc, B, of copper forms the chief part of the instrument; it is 50 mm. in diameter and 15 mm. thick. It is provided at its circumference with a number of radial screwed holes, in which the carbon rods (about 8 mm. in diameter) are screwed in such a way that they project about 50 mm. Before being inserted in their places, the carbon rods are saturated in various metallic solutions, and then dried; one of the rods is left unprepared, so that it can be used to show the ordinary spectrum of carbon. The plane of the disc, B, makes a right angle with the plane of the mirror of the projection apparatus, and scarcely cuts off more of the light than a single carbon does. In order to keep B in its proper position, the axle of B carries a disc, A, the contour of which is wave-shaped. By turning the axle, the spring, C, drops into one or other of the depressions, and keeps the disc steady in the corresponding position. On the disc, A, the symbols of the elements are engraved in an order corresponding to the order in which the prepared carbon rods are arranged. The disc, A, is outside the projection apparatus, so that any required element can be brought in position without difficulty.



The opposite electrode, either of a disc similar to the disc, A, or a single carbon, as shown in the figure. The sliding uprights, M and E, have attached to their lower extremities the ends of spirals of copper wire; the other ends of the latter being attached to the base plates, W and V.

THE ELECTRICAL EXHIBITION AT THE PARIS OBSERVATORY.

WE have already stated in previous issues of the REVIEW that the motive power required to actuate the different machines employed in lighting, and in the transmission of power, is supplied by a certain number of steam engines, representing about 200-H.P. In our esteemed contemporary, *L'Electricien*, we note that amongst the more important of the generators of electrical energy worked by these were the following:—

Three permutated direct current machines of M. Gerard. A small Edison machine of 15 ampères and 50 volts at the terminals. An alternating current Gramme machine, self-exciting, 20-light type. A Gramme machine, constructed by Messrs. Ducommun, giving 70 volts, 42 ampères, and feeding six Cance lamps. A continuous current Siemens machine. A Gramme machine, type A, and a second self-exciting Gramme machine for 20 lights. A compound octagonal Gramme machine, feeding a lamp having a candle-power of 500 Carcel burners, and the different machines for the distribution of motive power placed in various parts of the exhibition. Two alternating current magneto-electric machines, one with five discs and the other with two discs, by M. de Meritens, coupled together, and feeding 60 Cruto lamps of 50 volts and 1·2 ampères, and nine lamps of 50 volts and 2·6 ampères. A continuous current machine by M. de Meritens, feeding M. Aboilard's incandescence lamps. Four Gramme machines, two with a double ring, exhibited by Breguet.

The lighting of the hall was effected by means of two Breguet arc-regulators, and four Cance arc lamps.

The *Compagnie Electrique* exhibited some electric motors working a belt saw and a Ser ventilator, as well as the fans of the ventilating system worked by electricity, in use at the *Hotel de Ville* and at the *Ecole Centrale.*

Other motors worked by the same machine drove the Alanzet printing press, and the motor which put in motion the east dome.

In the exhibit of the *Ministère des Postes et des Télégraphes*, we will mention the secondary standards of the legal ohm; M. Blavier's tables of telluric currents; the Government telephonic apparatus, Sieur system, with microphonic transmitters and Bert and d'Arsonval receivers; the automatic transmitter for cable transmission, with siphon-recorder for receiver, the Brahie system; the Baudot apparatus, and a Hughes apparatus.

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* For several years past an apparatus devised by M. Boudreaux, and of which the principle is analogous to that described by the writer, has been used in Paris.

The room containing these apparatus was lighted by 72 Maxim incandescence lamps.

In the large hall were, amongst others, the following exhibitors :—

Aylmer.—Instruments for electrical measurement and telegraphy, made by Elliott, London.

Cauderay.—Instrument for measuring electricity or coulomb-meter.

Ducretet.—Instruments for measurement and instruction.

Edison Society.—Edison machine for small installations of electric lighting, and for charging accumulators.

Estienne.—Telegraphic system with reverse currents.

Hours-Humbert.—Measurer of electricity, reckoning the number of lamps per hour in fractions of six minutes.

Maiche.—Telephonic instruments ; micro-ohmmeter.

Menier. — Specimens of cables and conductors, ebonite electrical accessories (vessels, insulators, &c.).

Société Générale des Téléphones.—Complete collection of instruments, cables, and accessories in use with the systems employed at Paris and in the Departments. Apparatus for direct communication, Berthon system, allowing of direct communication between two given points (office and workshop, office and private address, &c.), without passing through the central station, at the same time leaving the two points free to communicate with the central station and free to be communicated with by it, together with all the other stations connected with the system ; instruments with synchronous clockwork movement, enabling six points of communication to be placed on a single wire ; instruments with polarised relays, for connecting two or four points on a single wire, Berthon and Ader system ; transmitter with carbon plates, Berthon system, and microphonic transmitter, Cael system, vertical type, employed in public telephone offices.

Ullmann.—Electrical gas lighters without battery, the spark being produced by a static induction machine, which is started by pressing a button.

Lazare Weiller.—Specimens of silicious bronze and various alloys.

Lighting.—The lighting of the hall was somewhat varied since it contained no less than four systems of incandescence lamps : M. Aboilard's, Swan's, fed by M. Jarriant's accumulators, 60 Edison lamps, and 24 Gerard lamps.

M. Gaston Planté showed each evening in another room his splendid experiments with a secondary battery of 800 couples ; the direct illumination of a Geissler tube by the continuous current furnished by these 800 elements in series, and experiments with the moving electric spark, representing globular lighting.

M. Gerard exhibited incandescence lamps of different powers ; machines with permutated direct current ; machines for the lecture room and laboratory, with accessories for showing the fundamental experiments of dynamic electricity.

Clémandot.—Magnets of compressed steel.

Recquier and de Messamre.—M. Gravier's ampère-meters and volt meters. Arc-regulator of M. de Messamre.

M. G. Trouvé's portable incandescence lamps and *M. Aboilard's* electric jewels attracted enormous crowds every evening.

M. Gaulard exhibited his new transformers with discs under the original name of secondary generators ; the firm of *Christofle* some specimens of casts, among which must be mentioned the bust of J. B. Dumas, a cast taken directly from the work of the sculptor.

In *M. Carpentier's* exhibit, which was most interesting, we must mention first of all the electric installation established at Breteuil for comparing standards of the ohm ; a model of a primary standard of the legal ohm ; a model of a secondary standard ; some practical standards in German silver ; some resistance boxes ; a series of galvanometers, graduated ampère-meters and voltmeters ; a direct-registering galvanometer, in which the error that might arise from the friction of the tracing point against the paper is very ingeniously avoided ; a Clamond battery constructed on a new model.

Breguet firm.—Lippmann's ampèremeter for 500 ampères ; an intensity compass for the measurement of terrestrial magnetism ; and a wire bridge, inductive or direct, to be employed either with the telephone or the galvanoscope.

The grand pavilion, which occupied the whole of the terrace of the Observatory, consisted of a central part and two wings placed at the two extremities. We must mention in the first place the exhibits of the companies of the *Nord and Paris-Lyon-Mediterranée* railways, which comprised the greater number of electrical instruments, which become more numerous every day, that are constructed for the prevention of railway accidents.

Among the batteries, we may mention the bichromate of potash elements with two liquids, and reversible movement by M. Radiguet ; the batteries of M. Cloris Baudet ; the peroxide of lead batteries of Messrs. Tommasi and Radiguet ; the peroxide of manganese elements of M. Warnon, &c.

M. F. Bellet exhibited some very interesting indicating and registering water levels, Parenthon system.

In addition to the above list, there were the usual electric bells and other accessories, the enumeration of which would only be a reproduction of the official catalogue.

The lighting of the central part of the pavilion was effected by means of a cluster of six differential lamps on the Siemens system.

M. Chaudron exhibited thermo-electric batteries and very fine plates of copper obtained by their employment in the reproduction of the blocks of the maps of the war department ; M. Thuion sent some electric accumulators from the Consolidated Electric Company, London, somewhat similar to the accumulators constructed by M. Kabath in 1881 ; M. Saninen exhibited a model of a flowing bichromate of soda battery, for the slow and continuous charge of the accumulators ; and some of M. E. Reynier's standard batteries and accumulators were on view.

The firm of Menier supplied gratuitously all the principal cables employed in conveying the current into all parts of the Observatory.

The lighting of the Conference Hall was effected by means of four Siemens arc lamps.

The outdoor lighting, and that of the east dome, was effected by twelve Jablochkoff candles, installed by the *Societe d'eclairage electrique.* The large light on the terrace, which lights up the whole of the avenue of the Observatory and projects its rays as far as the *Palais du Luxembourg* was installed by the firm of Sautter and Lemonnier.

In addition to these there were used in and about the exhibition two Breguet arc lamps, six Cance ditto, ten Siemens ditto, 72 Maxim incandescence lamps, 110 Edison ditto, 64 Gerard ditto, 100 Cruto ditto, and one Gerard incandescent lamp of 80 to 100 bec carcels, together with some lamps of Aboilard and Swan.

THE TELEPHONE AND TELEGRAPH COMMITTEE.

THE Select Committee on this subject has now adjourned for the Easter recess, but before doing so they had made such progress as to have completed the Post Office and telephone companies' part of the matter, unless it should be necessary to recall any witness upon some special point. On resuming the inquiry they will take up the case from the public point of view. Following the witnesses whose evidence we dealt with last week,

Mr. Thomas Fletcher, engineer of the United Telephone Company, was examined : He confirmed Mr. Morgan's explanation as to the kinds of wires used for telephones, and added that the standards for over-house wires were made of wrought iron, similar to those used by the Post Office, but that where the poles were fixed in the ground wood was generally used by preference. In all overhead work the wire was shackled off at each pole, and although varying according to circumstances, the spans averaged a run of about 100 yards. In crossing streets the wire was run as nearly as possible at a right angle, but way-leaves could not always be obtained at the exact spot desired. The wires were practically under constant inspection, and he observed that it was to the interest of the companies themselves to insure perfect condition for carrying out their undertaking. This inspection was most constant where the wires were most numerous, and he had no knowledge of any accident in the Metropolis through the breaking of a wire. He had little experience of underground wires, but such as he had bore out the statements of previous witnesses as to their greater cost as compared with underground wires. In like manner Mr. Fletcher agreed as to the further objections to an underground system arising from the fact that telephone wires spread in every conceivable direction, and the necessity of constantly opening the streets in order to lay fresh wires as new subscribers came in.

Mr. Radcliffe, telegraph engineer to the Great Northern Railway Company, estimated the cost of underground wires at ten times that of overhead lines, and put the cost at as much as £1,000 a mile where a wooden or asphalted street had to be opened. He mentioned that the British and Irish Magnetic Company originally laid their wires under the ground, but after their amalgamation with the Electric Company they abandoned that system and adopted pole lines. During a long and extensive experience he had known of no accidents, and in recent years great improvements had been effected in the materials used and the methods of fixing overhead wires.

Mr. John Fletcher, telegraph engineer to the London and North Western Railway Company, was likewise examined, as an independent witness, and he spoke in a similar tone of the great cost and inconvenience of an underground system, as well as the difficulty in regard to greater induction. The Corporation of Manchester at one time thought of laying underground wires, but after consulting him they abandoned that intention. He was in favour of a system of supervision, and would have no objection to bye-laws being framed by local authorities subject to the approval of the Board of Trade. The London and North Western Company had a large number of telephones in use, especially for signalling purposes.

Mr. James Moseley then gave some further evidence from the telephone companies' point of view, in his capacity as chairman of the Lancashire and Cheshire Telephonic Exchange Company. This company, whose head office is in Manchester, have 48 exchanges in the two counties over which they operate; 3,000 subscribers, and 889 renters of private wires, the whole representing a total income of £67,000, as compared with £22,000 in 1881. The subscription in Manchester and Liverpool is £20 a year, but in other districts it varies according to the requirements of the public. Besides the exchanges and private wires, they have 53 call-offices open to the general public, anyone of whom can have three minutes communication in the town for 3d., and through the trunk wires for 6d. These call offices have only been recently opened under the new concessions made by the Postmaster-General, but during their two months' existence 43,466 messages have been sent along the trunk wires, 4,086 of which originated at the call offices, 31,270 were from subscribers to the trunk system and 8,000 from ordinary subscribers to the exchanges. The company further have a system of telephonic communication between the various fire stations, and also between a number of police stations throughout the two counties. All this work is carried out by means of overhead wires, the company having none underground. Up to two years ago they used No. 11 galvanised iron wire, but now they use, and will continue to use, hard-drawn copper wire. The main objections to underground wires are, in Mr. Moseley's view, two: 1, the commercial difficulty arising from the enormous cost; 2, the electrical difficulty due to the increased resistance in all underground wires; and on the latter point he explained that there was a danger from the stronger current, of the messages being rendered weak and undefinable. Then there is a third difficulty in Lancashire, viz., that the business is not confined to Liverpool and Manchester, but is spread over the whole county, and if the telephone is to be of service to that great commercial community there must be an extensive town-and-town connection. Then to obviate defects of induction two wires must be used to form metallic circuits, and if an underground system were adopted simply in a town, but overhead wires outside, it would be necessary to carry a metallic circuit in continuity of the underground wires in the town. And if a long distance were being dealt with the enormous resistance of the two underground circuits at each end would make the transmission of telephonic messages commercially impossible. From a consideration of all these points, Mr. Moseley contends that an underground system is impracticable, and as to the question of danger, he also knows of no case in Lancashire or Cheshire of danger arising from the breakage of a wire. There was one accident by which two persons were killed and a third injured at Oldham through a fire escape of the old upright type dragging a wire and bringing down with it the coping to which it was attached. For this, however, Mr. Moseley, holds the fire escape to blame, mentioning that an improved escape has now been adopted. Going to another point, he said the practice of his company has been to obtain permission to erect poles, and, although they have had many difficulties in that respect, they have fixed 7,989 standards, made 20,813 attachments and run 5,300 miles of wires. This, he thinks, shows that there are methods of overcoming individual objections, but he advises the adoption of some mild form of compulsion under which the company would have an absolute right, and without an appeal, to cross private property, so long as the wire did not touch the property. At all events, a reference to the Board of Trade would be the simplest and most effectual way of arriving at some general principle for carrying out telephonic work. This right he would not extend to the making of attachments, and he contemplates and is prepared for local authorities making bye-laws, subject to the approval of the Board of Trade.

On the subject of the practicability of underground wires, Mr. Moseley was asked whether that was not successfully carried out in Newcastle, and to other towns. He replied that he believed it was restricted to Newcastle, and so might be practicable, while it would not be over a county; but he admitted that if it did actually extend to other towns and was satisfactory, it would be folly to say it could not be done, and, in that case, his judgment would have to yield to the accomplished fact. Telephone wires, he explained, would not last more than about a year in an atmosphere impregnated with chemicals, because of the sulphuric acid in the air, but in other districts a wire would endure for four or five years. With regard to inspection and examination, they arise in the ordinary course of business, in order to secure perfect communication, a defect in a wire at once indicating itself.

Reverting to the question of further facilities and control, Mr. Moseley told the committee that the companies would be content if the local authorities had the same powers with reference to telephones as they had in regard to telegraphs; and that they would be willing to accept any reasonable terms from the Postmaster-General with a view to extending the system of call offices. Except in a few special cases, they had not been able to run their wires along railways, because the Post Office claimed an absolute monopoly in that respect under their Acts.

Colonel R. Raynsford Jackson, Chairman of the National Telephone Company, being also examined, stated that that company had 23 exchanges, and were prepared to establish many more, especially under the enlarged powers given by the Post Office. They supplied Scotland, Ireland, and generally the Northern and Midland Counties in England. They used in Scotland phosphor-bronze wire, and in England hard-drawn copper wire, only using iron wire for trunk lines along the highroads. They had had only two slight accidents from the breakage of wires, and, as a rule, had had no difficulty in arranging with local authorities. He was decidedly in favour of overhead wires for every reason, and he explained that his company's system was all overhead except in Birmingham, where they were obliged to make it underground owing to some special considerations in connection with building operations. As to the restrictive effect of underground wires generally, he agreed with previous witnesses, and he likewise urged that the telephone companies ought to have some sort of compulsory power to take their wires where they wished, provided no nuisance or noise were created by the wires, and the wires were placed sufficiently high to avoid public inconvenience. In fact the use of the telephone was a matter of such importance to the public that it ought not to be in the power of any individual to hamper its development.

During the sitting at which this evidence was taken,

Mr. Hunter, the solicitor to the Post Office, submitted to the committee a draft of suggestions on behalf of the Post Office, for the alteration of the present law. With regard to telegraph wires, it was suggested that on the Postmaster-General intending to erect a wire, he should be empowered to give notice before instead of after obtaining the consent of the road authority, to persons within 50 feet of the roadway, and to the owner of any park or pleasure ground, and that such persons might be able to send in objections to the proposed line within a limited period to be decided upon; then that such objections should be referred to some tribunal (say the County Court Judge), which should have power to issue an order authorising the erection of the proposed line on proper conditions, an appeal being given to the railway commissioners, the Postmaster-General being free to proceed with the line if an appeal should not be prosecuted with effect within a fixed term. Another proposal was, that the Postmaster-General should be authorised to make attachments to private property without first obtaining the consent, except of the occupier, such arrangement, however, to be restricted to the term of occupancy, and finally that any provisions of existing Acts, inconsistent with these conditions, should be repealed, especially that requiring notice to occupiers of houses within 30 feet of a proposed pole. In the next place, with reference to telephone companies, the Postmaster-General suggested that the existing conditions and provisions, as above amended relative to overhead wires of the Post Office, should be extended to all other persons having occasion to make such wires; that the lessees of the Post Office, and not other persons, should have the same privileges in regard to underground wires as the Post Office, and that both in respect to overhead and underground wires the Postmaster-General should have a veto upon the erection of such wires if they were likely to injure any Post Office line, or occupy a limited space which he would require within a year.

At the final sitting before the adjournment, the committee took the evidence of Mr. J. S. Forbes, deputy chairman of the United Telephone Company, and Mr. Winterbotham, solicitor to that company.

Mr. Forbes, after referring to the negotiations and agreement with the Post Office as to the relative rights of that department and of the telephone companies, when the telephone was first introduced, said the development of the telephone was still very much impeded by the restrictions imposed by the Post Office; the Post Office having paid a high price for the telegraphs, no doubt considers that they ought to protect their purchase as much as possible. Happily experience, which taught everybody, was teaching the Post Office that they must relax their restrictions. The companies were, however, existing on sufferance, and that prevented their doing all that the public required. He doubted whether the Post Office had realised the multiplicity of ways in which the telephone could render valuable service. He thought every railway station adjacent to a town ought to be connected with the centre of the town as a matter of public convenience, but that could not be done without legal facilities outside the caprice of any individual or even a public body. He believed the time had come, or was very near, when the telephone, like other public enterprises of great moment, must have something like a compulsory power, of course having due regard to existing interests. It had already been of too much utility to be allowed to exist only at the caprice of individuals, but his company had only been able to supply about 4,000 subscribers by the tolerance of people, including even some of their own subscribers. With regard to the question of control, Mr. Forbes said he was fond of control for he regarded it as generally beneficial, and besides, if he was undergoing control, he could also exercise control. For this purpose he could imagine no better authority than the Metropolitan Board of Works for London, with an outside public tribunal, in the event of any vital difference arising between that Board and a company—either a Department of the State or one of the Courts. The telephone was being largely used for signal boxes, but he wished to have the large railways, which now had so much in common, linked together by telephones, so that the managers could arrange any matters in a few moments without leaving their offices. In such a necessity, for instance, as the movement of troops from one part of the country to another, such a facility would be of the greatest importance. Apart from the convenience, the great gain in point of time between telephone and telegraph was of immense importance. The result of the present restrictions was that the companies could not always obtain wayleaves, and they could not even run wires along the railways, because in a moment of weakness the railway companies sold their rights in that respect to the State and so only Post Office wires could be run in that way. He thought it was obvious that overhead wires must be preferred to underground wires for telephones, but to allay the apprehensions of the public (whose nervousness was due to ignorance) some guarantee of the safety of overhead lines must be given. The telephone companies ought to have facilities and rights for making attachments and fixing poles without being liable to payment unless damage was done. In the same way they should have power to cross lands and houses on paying for damage or inconvenience. For telephonic purposes it was absolutely necessary to have overhead wires, and if they were not allowed the telephone could not be carried on commercially, complaints being heard even now as to the cost. With regard to telephones between railway stations, the London, Chatham and Dover Railway Company would, he knew, be willing to give facilities between London and the principal stations in the country. There were some telephones on the District Railway, but some difficulty had arisen respecting them with the Metropolitan Company, and the matter was still pending. Most of the telephones were open day and night, and that, he thought, would be necessary in London, and his company hoped to carry that plan out. He should be content to work under some intelligible law, reasonably exercised, but some compulsion as to erecting wires was essential. For the Metropolis outside the City the Board of Works might make bye-laws, and as to the City they might perhaps arrange with the Commissioners of Sewers. Being asked questions respecting Messrs. Travers' case, Mr. Forbes said he thought that if the Legislature went so far as to give compulsion, the Telephone Company ought to have power to erect on that firm's premises a pillar bearing a multitude of wires, for, although to a certain extent Messrs. Travers' objections were valid, if it was agreed that the telephone was of public utility, it should not be retarded by the caprice of individuals. On the other hand, he admitted that any arrangement with an occupier should be limited to the tenancy, and any compensation for damage or inconvenience should go to the tenant. He would also give a nominal sum—something in the nature of a peppercorn rent—for admission over land. Finally Mr. Forbes declared his conviction that whether the telephone was developed by the Post Office, or by the delegates of the Post Office, it was of such public utility that sooner or later Parliament would be obliged to give further facilities.

Mr. Winterbotham, of the firm of Messrs. Waterhouse, Winterbotham and Harrison, solicitors to the United Telephone Company, described the Act of 1863, and its bearing on the question of passing over property, and, summing up what the telephone companies desired, said the telephone was so necessary and was becoming so increasingly important, that facilities must be given to enable the companies to connect subscribers as speedily as possible. As to what was requisite for that purpose there might be some difference of opinion, but he believed it would be agreed that where there was permission to erect poles there should be power to pass over intervening property without asking leave of the owner, subject, of course, to payment for damage, to the removal of wires if the owner subsequently required the use of the property, and to proper regulations, under which they would be in the same position as the Postmaster-General.

The committee will resume the enquiry on April 16th.

Cable for Japan.—The ss. *Flintshire* left her berth off the factory of Messrs. Siemens Brothers on Tuesday last, after having shipped some 70 miles of heavy cable for Japan. She will complete her cargo in dock before sailing for Yokohama.

REVIEW.

The Electrician's Directory, with Handbook, for 1885. London: "Electrician" Office.

In the new issue of this yearly publication one or two improvements have been introduced, including a number of new tables of interest to those who are engaged in electrical operations. The list of local authorities and the chief officers is more complete, and the list of alphabetical and classified names is very largely increased. A totally new feature is to be found in the biographical section, in which a more or less brief biography is given of those whose names are best known in electrical pursuits, this section being illustrated with a number of portraits.

NOTES.

The Alexandra Palace.—At this popular place of entertainment, which was re-opened on Tuesday last, the electric lighting of the buildings and grounds has been executed by the Gülcher Electric Light and Power Company. In the dynamo house at the west end of the building are four machines in actual use, with an additional one ready to switch on in case of emergency, the steam-power being derived from a 30-H.P. Robey engine. The outdoor lighting is served from two dynamos in a house out in the Grove, which are driven by two engines made at the Battersea Works, of 10-H.P. each. In the building there are in the towers four arcs of 3,000-candle-power, and in the east transept, one; in the winter garden four, of 2,000-C.P.; in the Italian garden, two; in the corridors, six; in the picture galleries, eight; in the grand transept, fourteen; in the central transept, seven; in the east transept, two; and in the forestry, four; while outside the building there are in the grove eight arcs, of 2,000-C.P.; one, of 3,000-C,P.; in the Japanese Village four, of 2,000-C.P.; and in the drive one, of 2,000-C.P.; making a total of sixty-six arc lamps. The band stand is ornamented by incandescent lamps of various colours, and in the refreshment bar are incandescent lamps also; the total of these being 219. All the outdoor wiring is done with naked wires carried on insulators, this part of the work having been attended to by Mr. Harrison, who has had considerable experience at the Crystal Palace and elsewhere. The whole installation has been carried out under the superintendence of the company's electrician, Mr. Fricker. We believe the number of men employed on the work would not at any time have exceeded one-tenth of the figures given in one or two papers (300 to 400), which has evidently arisen from some mistake.

Electric Search Lights for our Gun Boats.—The necessity for supplying our war ships with the electric light is now thoroughly recognised, and the furnishing of our gun boats with the requisite dynamos and engines is now being rapidly pushed forward. Amongst the latest additions to the list of ships provided with electric search light apparatus are the *Leander*, the *Racer*, and the *Mariner*, each of which has been fitted with a special slow-speed Victoria dynamo, manufactured by the Anglo-American Brush Electric Light Corporation; these compact dynamos, which are held in such high estimation for ship lighting, are coupled to three-cylinder Brotherhood engines; and in addition to providing the current for the search lights, some of them are also used to furnish the current for the Victoria incandescence lamps, with which the interior of the boats are illuminated.

Preparations are also being made, and the necessary apparatus provided, for the *Mariner's* guns being fired by electricity.

The Electric Light in Germany.—Although the Edison Company has now got a favourable decision against the Swan Company in respect to the use of the filament lamp, it is not without competition in Germany. In a case of interference between Edison and Bernstein, the hollow carbon of Bernstein was declared independent of the Edison claim on the filament, and Bernstein lamps are sold in Germany as usual, irrespective of any claims of the Edison Company. We understand that the Bernstein Electric Lamp Company are about to commence manufacturing in England.

The Duration of Glow Lamps.—The trials made at the Edison works, at Ivry, near Paris, with Edison lamps of 16 candles and 100 volts, prove that the duration of these lamps diminishes considerably with the use of an electromotive force above the normal tension. Thus, according to the figures of M. G. Fossat :—

For 100 volts, the mean duration is	...	1,000 hours.
„ 99 „ „ „	...	1,277 „
„ 98 „ „ „	...	1,645 „
„ 97 „ „ „	...	2,135 „
„ 96 „ „ „	...	2,751 „
„ 95 „ „ „	...	3,595 „

On the other hand, with an electromotive force of

100 volts, the mean duration of the lamps is	1,000 hours.
101 „ „ „ „ „	785 „
102 „ „ „ „ „	601 „
103 „ „ „ „ „	477 „
104 „ „ „ „ „	375 „
105 „ „ „ „ „	264 „

—*La Lumière Electrique.*

Electric Lighting of the New Oaks Colliery.—Last Saturday night the New Oaks Colliery, Barnsley, was lit for the first time by the electric light. There were over 150 incandescence lamps (Muller's patent) in use. The whole of the surface, including manager's house, offices, engine houses, mechanic and lamp shops, waggon ways, yards, pit bank, screens, loco. shed, coal washers, boiler houses, and brick sheds, including the pit bottoms and principal roads were lit, and gave great satisfaction. Each lamp is controlled separately, and switches and safety fuses are inserted into each main branch and lamp circuit. The dynamo machine is driven from the fan engine, and is of a self regulating type. This is the largest electric light installation that has ever been put into a colliery. It was erected and lighted by the Simplex Electric Light Company, Limited, Valley Mills, Eccles, Manchester, under the superintendence of Mr. F. F. Bennett, who was heartily congratulated on the success of the installation.

The Electric Light at Suakin.—Great use is being made of the electric light in connection with our campaign in the Soudan, more especially at Suakin, where the authorities have determined to place two powerful search light projectors, in addition to those in use on board the ships in the harbour; these, together with the two dynamos to feed them, are being supplied by the Anglo-American Brush Electric Light Corporation, and will be ready very shortly for shipment. Advantage has also been taken of the electric light, as we have before stated, to enable the railway from Suakin to Berber to be pushed forward much more rapidly than would have been possible without its aid. A very serviceable plant has been secured in the four "Brush" dynamos furnished by the Anglo-American Brush Electric Light Corporation, which supply current for 32 Brush arc lamps. Arranged in groups, on different parts of the works, the dynamos are driven by Parson's four-cylinder engines, manufactured by Messrs. Kitson & Co., of the Airedale Foundry, Leeds. These engines are well covered in and protected; indeed, it would be difficult to imagine an electrical plant better suited, as a whole, for maintaining the light under trying conditions, than that supplied for these works; even the 4,000 yards of cable to be used for conveying the current has been armoured with iron wires to make it capable of standing any amount of wear and tear to which it may be subjected.

Electric Light at a Shale Mine.—Mr. Young's Paraffine Light and Mineral Oil Company, Limited, has adopted the electric light at its Newliston Mine, near Edinburgh. Two powerful 16-hour arc lamps are used, hoisted on poles 50 feet high, and give a very brilliant light over the whole working space aboveground. The dynamo is driven by the workshop engine, and is arranged to slide on its seat so that the belt can be tightened or slackened when running. The work was carried out by Messrs. Henry Bennett & Co., electric light engineers, Glasgow, to specification by Mr. Alex. Morton, consulting engineer.

The Salvation Army and Electric Lighting.—A large public hall is being built for the purposes of the Salvation Army at Burne Street, Edgware Road, and the architect, Mr. E. J. Sherwood, of 101, Queen Victoria Street, is advertising for tenders for lighting it by electricity. The building consists of a large upper floor for devotional meetings, for which arc lamps are to be used, and a basement in which tea and other meetings will be held, for which the incandescent system will be adopted. It is in contemplation, if this experiment is satisfactory, to introduce the electric light at the Eagle and some of the other large halls of the army.

The Bell Patent in Austria.—The Imperial and Royal Ministry of Trade, and the Royal Hungarian Ministry of Agriculture, Industry, and Trade, have decided on the petition of Otto Schaeffler, Mechanician of Vienna, bearing date December 20th, 1882, represented by Dr. Karl Bitter von Sääl, Court-Advocate in Vienna, against Alexander Graham Bell, of Boston, represented by Dr. Victor Hasenhörl, Court-Advocate in Vienna, for a partial annulment of the privilege granted to the said Alexander Graham Bell, December 16th, 1877, with the priority of 1 p.m., August 8th, 1877, for "improvements in electro-telephony," on account of want of novelty in the patent claims 11 to 16, inclusive; after hearing the defendant, and obtaining the opinion of experts: that the petition in so far as it is directed to a declaration of the nullity of the patent claims 13 and 15, in accordance with the enactments of section 291, *a*, *bb*, in connection with section 1 of the law of privilege of August 15th, 1852, is admitted, and the privilege in question as regards the claim 13, to wit: "In an electric telephone the combination of the plate with a magnet, with coils at its end or at its ends near to the plate, essentially as described," and the claim 15, to wit: "In combination with an electric telephone, as described, the use of a speaking or hearing trumpet to conduct the sounds to or from the telephone, essentially as described," are declared null and void, on account of the want of novelty. On the other hand, in so far as the petition is directed to the annulment of the claims 11, 12, 14 and 16, it is rejected as unfounded, and the privilege attacked will herein be upheld.—Vienna, March 1st, 1885.—*Amtsblatt zur Wiener Zeitung.*

The Bell Telephone Patents in Canada.—A despatch from Montreal to the *New York Evening Post*, dated March 19th, states that the Dominion Telephone Company has instituted a relentless war against the Bell Telephone Company, and having been successful in annulling the privileges granted by the Dominion Parliament for the Bell patent, had that day instituted proceedings to annul the Blake, Phelps, Anders, and Edison patents, held by the same company. This action is said to be based on the same grounds as in the case of the Bell patent, in that the company has failed either to manufacture or sell the patented articles in the dominion as required by the patent laws.

The Western Counties and South Wales Telephone Company.—This new company is making considerable progress in the district which it has recently taken over, and has already extended its operations into most of the principal towns in Hampshire and Dorset. There are a large number of private subscribers at

Poole, where an extensive trade in timber and coal is carried on, and where there is reason to believe the facilities which have been provided for inter-communication have had a most beneficial effect in increasing business. There is every probability that in course of time Poole and Bournemouth may be telephonically connected. Notwithstanding the fact that Southampton is the centre of large commercial interests, the company has not met with that support in its efforts to establish an exchange which might have been desired; but a number of tradesmen have availed themselves of the advantage of having their various places of business connected; and, in course of time, we doubt not that we shall be enabled to record that Southampton, like many other towns of the same size and importance, can boast of a telephone exchange.

The City Commissioners of Sewers and Overhead Wires.—At the fortnightly meeting of the City Commissioners of Sewers, held at the Guildhall on Tuesday afternoon, Mr. James Scott introduced a motion to refer to the Finance, Improvement, and Streets Committees the question of the acquired rights or assumed powers of the United Telephone Company to run its wires over the houses and streets within the jurisdiction of the court; to refer to the same committees certain correspondence between the Telephone Company, Messrs. Travers & Co., and the Postmaster-General; and that the solicitor be instructed to report on the legal and other rights of the Telephone Company so far as they may affect the court and the public; and that the committees and the solicitor bring up a report at the earliest possible date. Mr. Scott stated that it would be admitted, he thought, that the question of overhead wires was becoming a very serious one for all parts of the metropolis, and in no place was it more serious than in the City. The telephone companies were assuming the right to attach their wires to public buildings and private houses, and for this purpose their men came into places of business and private dwellings whenever they pleased, to fix and look after their wires. There was a general impression that they assumed more power and authority than Parliament had given them, and it behoved the court, as the guardians of the streets of the City, to see how far the telephone companies could go. Mr. Brookman seconded the motion, and said that if the United Telephone Company were permitted with impunity to proceed in its present course, other companies would follow its example, and the nuisance of overhead wires would become so great that in the course of 10 or 20 years a serious disaster would happen to London, by some snow-storm breaking down the wires, doing serious injury to the business of the City, and inflicting, perhaps, much injury to life and property. He strongly advised that all such wires should be placed underground. Other members spoke in the same sense, and the motion was unanimously agreed to. Mr. Brookman evidently speaks without any special knowledge upon this subject, and he would do well to read the proceedings of the Committee on Telegraph and Telephone Wires in this and our previous issue.

The Central and South American Telegraph Company's Cables.—We understand that the United States Government is despatching all its available vessels to the Central American ports, with special instructions to protect the cables of the Central and South American Telegraph Company, as Barrios, the President of Guatemala, ascribes the premature disclosure and possible miscarriage of his plans for the confederation of the Central American Republics, to the rapidity of communication, due to the existence of these cables. The United States Government has telegraphed to its representative in Guatemala in the mean time, asking him to inform the authorities of that country that they would be held responsible to the United States Government for all damage caused to the cables which are the property of American citizens.

The Proposed West African Cable.—A Reuter's telegram from Lisbon states that the Chamber of Deputies on Monday sanctioned the contract concluded by the Government on July 9th last year for the laying of a cable establishing telegraphic communication with the West Coast of Africa.

We learn that the ss. *Electra* left Plymouth on Saturday last, having on board Mr. J. Pender, M.P., who takes with him an influential friend; these gentlemen will land at Lisbon. It appears that matters, connected with the proposed new cables referred to above, have not been progressing so satisfactorily as the interest of the combined companies would dictate and that a little pressure will have to be brought to bear on the Portuguese Government. We believe that the hitch is due to the imprudent importation of political bias into the management of the affair in Portugal. It seems that a paper was published and placarded there which, while purporting to be for the information of the shareholders of the Brazilian Submarine Telegraph Company and while expressly disclaiming any necessity for political feeling in the matter, was not circulated amongst the English shareholders, and was practically a covert attack on the action of the Portuguese Ministry. It is, we believe, to clear up this misunderstanding in the interest of the combined companies (the Brazilian Submarine, the Eastern, the Telegraph Construction and Maintenance, and, we hope we are not indiscreet in adding, the Anglo-American Companies), that Mr. J. Pender, M.P., and his friend have gone to Lisbon. The ss. *Electra* is expected to have arrived at Lisbon on the *First* of April. After landing these gentlemen at that port she will proceed to Suakim to assist the other ships, the *Kangaroo* and *Calabria*, in condensing water for the troops. The *Kangaroo* is expected to arrive at Suakim about the 5th inst.

Telegraphs and Low Prices.—The *Contemporary Review* for April has an article upon "Present Low Prices and their Causes," from the pen of Mr. William Fowler, M.P., who in the course of his paper says:—"The effect of telegraphs on prices may not be so obvious, but it is very important. Formerly it was part of the business of a foreign merchant to hold large stocks of goods, and thus great amounts of capital were locked up in foreign ports. Very small stocks, if any, are now needed. English prices are as well known in Calcutta as in Cornhill, and the merchant can give his orders by wire without the delay of correspondence, and without any risk as to an alteration of price between the time of writing and the despatch of the goods. A merchant can afford to work at a less remuneration if his capital, formerly locked up, remains free for use in other ways, and if his risk as to price is reduced; and thus the operation of transmission of goods involves much less influence on prices than was formerly the case. The chances of profit are lessened by this process of telegraphing, and men of small capital can compete when formerly they would have been powerless; but such competition tends to lower rather than enhance prices. Thus, directly and indirectly, invention annihilates space and time, and brings vast supplies at the lowest possible cost to our open market, and that without any reference to the character of existing demands; so that we see the general phenomenon of supplies out of all proportion even to demands which have enormously increased with increasing populations, and greater desire for the luxuries and conveniences of life. An even greater fall in prices would not have surprised me."

Telegraph Battalion for the Soudan.—The first section of the Telegraph Battalion, Royal Engineers, consisting of Captain C. F. C. Beresford, one serjeant, and 44 rank and file, has left for Suakin in the *Ghoorkha.*

The Telegraph in Central Asia.—Intelligence comes from St. Petersburg that telegraphic communication has been established between Askabad, Sarakhs, and Merv.

Sixpenny Telegrams.—In the House of Commons on Monday night, Mr. Shaw Lefevre resumed the adjourned debate on the motion for leave to bring in a Bill to amend the Telegraph Acts, 1863 to 1878. He stated that his object was to state the intention of the Government with reference to the introduction of sixpenny telegrams. It was now arranged that the new tariff should come into effect on the 1st of August next. His predecessor had come to no determination as to what the new tariff should be; but he had appointed a departmental committee to advise the Government as to the financial cost of the various tariffs which had been suggested to the Government. The telegraph service had not improved, but very much the reverse since 1881, as since that year there had been a reduction in the profit of nearly £200,000. This reduction was due to two causes—first, the addition to the salaries of the telegraphists recently made; and, secondly, the fact that the plant which had been taken over by the Government had within the last two or three years got into bad repair, and it had been necessary to replace it. The present tariff led to unnecessary and superfluous work, because under the Telegraph Act of 1868 the address must be sent free, and no care was taken to contract messages as much as possible. The number of messages now sent by the telegraphic service was 24,000,000, the average receipt on each message was one shilling and a penny, while the average cost of each message was tenpence. If the Government gave for sixpence what they now gave for a shilling, they would receive half the money they now received. Yet the cost would remain the same, and that would entail a loss to the department of £650,000 a year. Such a loss was obviously altogether out of the question, and would be financial ruin to the service. He had, therefore, come to the conclusion that the best tariff both for the public and the department would be one giving twelve words for sixpence, and a penny for each additional two words, and that this should include both the words in the address and the words in the text. In other words, the free address would be abolished. The tariff, in fact, would be a word rate of two words for a penny, at a minimum charge of sixpence. He estimated that the addresses would average five words, which would leave seven words for the message. He believed that the receipts would be reduced from 1s. 1d. to 10d. per message, and that the average cost would be reduced from 10d. to 8¾d. He estimated that this reduction would cost £180,000 a year, and that the actual profit would not be more than £250,000. But he would do the utmost that the present means of the service permitted to make the new scheme successful. After some discussion leave was granted, and the Bill was introduced.

On Tuesday evening Mr. Shaw-Lefevre brought in the Bill, which was read a first time. Later the same evening Lord J. Manners gave notice that on the second reading, or on the next stage most convenient, he would move an amendment for the purpose of retaining free addresses.

Mechanical Governors for Engines driving Dynamos.—Mr. Willans says that, assuming a dynamo machine is, in the first instance, perfectly compounded, but that the resistance of the leads introduces a loss of 7 per cent. in the electromotive force when the maximum number of lights is in use, this loss practically disappearing when the lights are at their minimum, the motor should obviously be so regulated that its speed should increase by nearly 7 per cent., as the lights are turned on. A centrifugal governor would so regulate the motor's speed that, instead of increasing it would diminish it, probably to the extent of 5 per cent., and the result would be a serious reduction in the power of each individual light.

Electric Motors.—The Van Depoele Electric Manufacturing Company has sold an outfit for 10 miles of street railway, on which the motive power will be electricity, in Kansas City, Mo.

The Bell Patents in England.—A rumour is flying about the Patent Office that the United Telephone Company is about to apply for a disclaimer on the Bell patent. That some such step would be necessary was indicated in a letter published on February 18th, 1882, in this paper. (See p. 127.)

Test of an Electrically-propelled Tramcar.—On Tuesday a trial-trip was made from the depot of the South London Tramways Company, Queen's Road, Battersea, of a car fitted with Reckenzaun's patent electric motor and gearing (described in the REVIEW for December 20th, 1884). A number of the members of the Wandsworth District Board of Works and officials of the South London Tramways Company and several provincial tramways companies and other persons witnessed the trial, Mr. Alexander Siemens being also present in a consultative capacity to the Board of Works, whose consent is necessary for the proposed continued running of the car on the lines of the tramway company. A pleasant and successful run was made about a mile out from the depot in one direction, the car, with Mr. Reckenzaun in charge, moving at a fair speed and very smoothly; unfortunately, however, on the return journey a bad connection and consequent heating of a portion of the apparatus caused some delay. The source of disturbance was eventually discovered, and the car proceeded back to Queen's Road station, where the depot is situated, and then continued on its way about another mile towards Battersea Park. The remainder of the trip passed off without mishap until the depot was again reached, when, owing to the looseness of the junction rail, the car, a very old and heavy one, ran partially off the line. Manual power and the motor restored it to its proper position, and after it had been run into the shed Mr. Reckenzaun explained the working of the apparatus to the apparent satisfaction of the gentlemen assembled.

Dynamos and Projectors for Torpedo Boats.—Foreign governments, as well as our own, now find that even the smallest of the vessels which are used for war purposes are not satisfactorily equipped unless they are provided with a powerful electric light, and for this reason it has been decided to fit the two torpedo boats building for the Spanish Government at Messrs. Thorneycroft and Co.'s Torpedo Launch Works, Chiswick, with the requisite electrical plant, which is now made in such a compact form that it encroaches very little on the limited space available in boats of this class. The particular dynamo and engines selected for these launches are the Victoria dynamos manufactured by the Anglo-American Brush Electric Light Corporation, coupled to Brotherhood's three cylinder engines; they are both mounted on one bed plate, and form a picture of compactness. These torpedo boats are also to have the great advantage of the cabins being lit by Victoria incandescence lamps, which can be done by using the same dynamos for the incandescence lamp as that which is required for the search light circuit.

Ribbon Wire for Dynamos.—We have received from Messrs. Adam Millar & Co. some excellent samples of their patent covered ribbon wire, which is prepared for winding the coils of dynamos, motors, &c. It is nearly rectangular in section, and may therefore be coiled into a smaller space than round wire, and, from its great flexibility, it may be coiled with less strain.

The Inventions Exhibition.—The Varley Electric Patents Proprietory will exhibit, at the coming Exhibition, its "Miniature" arc lamp, incandescent lamps, primary and reversible primary or secondary batteries, electric current meters and flexible carbon, all of which are referred to in the prospectus of the Proprietory, to be found in our City columns.

Inventor's Institute.—Major Deane has resigned the secretaryship of the Inventors' Institute.

Effects of Lightning.—The *Journal of the Royal Meteorological Society* for the present quarter contains papers by Mr. C. C. Walker on "Injury by Lightning to the Monument to the first Duke of Sunderland, at Lilleshall, Shropshire, April 28th, 1884," and by Colonel A. Parnell on "The Mechanical Characteristics of Lightning Strokes."

Electrical Catalogue.—The excellent publication of Messrs. Weedon and Irish, of Sunderland and London, forms a full and most complete catalogue of electrical appliances, electric lighting being especially dealt with in great detail, whilst telegraph and telephone plants are also amply illustrated and described.

Natural Forces.—Prof. Tyndall, F.R.S., is announced to deliver a course of five lectures at the Royal Institution, commencing on Thursday, April 16th, on "Natural Forces and Energies."

Overhead Wires in Philadelphia.—The chief of the electrical department of the City of Philadelphia, Mr. Walker, stated in his annual report recently that during the year there were issued 737 permits for the erection of poles and wires, but only 190 new poles were erected. At the close of the year there were on the highways of the city 4,631 poles, exclusive of those along the lines of railroads; 4,499 miles of telegraph and telephone wires, 115 miles of electric light wires, and 341½ miles of underground wires. Belonging to the city there were 3,449 poles and 411 miles of telegraph wire, making a grand total of city and other overhead wires of 5,025 miles and 8,080 poles. Mr. Walker, in another part of his report, remarks that the making of overhead wires reliable in large cities has become almost an impossibility, owing to the interruptions caused by contact from the great number of wires over the streets and across buildings, and from the breaking and falling of wires upon those beneath them.

NEW COMPANY REGISTERED.

International Electric Railway Syndicate, Limited.—Capital, £10,000 in £1 Shares. Registered Office: 43, Devonshire Chambers, Bishopsgate Street Without, E.C. Objects: To take over the business carried on by Mr. Jacques Binko, trading as "The International Electric Railway Company," and also to acquire a concession, dated 31st January, 1884, for the construction and working of an electric railway at the Alexandra Palace. Signatories (with one share each): Jacques Binko, 11, Stradbroke Road, Highbury; R. Nevin, 43, Devonshire Chambers, Bishopsgate; T. Brandreth Gibbs, Dunster House, Mark Lane; Major de Winton, South Norwood; A. A. Daly, 43, Devonshire Chambers; H. Oakley, 11, Broseley Terrace, Crouch Hill, N.; A. W. Buckingham, Ipswich. The signatories are the first directors. Remuneration, £2 2s. to each director for every meeting attended, and an additional sum of 10s. 6d. to the chairman. Registered 27th ult. by Mr. T. Hulbert, 6 and 7, Coleman Street.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Medical Battery Company, Limited.—An agreement dated 7th ult. (filed on the 24th ult.) provides for the purchase of the business of Mr. C. B. Harness, of 205, Regent Street, with the furniture, stock in trade, patent rights, &c. The consideration is £60,653 16s. 1d.; payable, £653 16s. 1d. in cash, and the balance in fully paid shares. Mr. Harness is to be appointed managing director for at least seven years, at a salary of £1,000 per annum. The company will also purchase the business and effects of the Pall Mall Electric Association Limited, for 5,000 fully paid shares.

Chelsea Electricity Supply Company, Limited.—The statutory return of this company made up to the 19th ult., was filed on the 25th. The nominal capital is £100,500, in 20,000 shares of £5 each, and 500 founders' shares of £1 each; 120 of the £5 shares have been taken up, and £2 10s. per share has been called thereon; the calls paid amounting to £227 10s., leaving £72 10s. unpaid. Registered office, 5, Lime Street Square, E.C.

Dollond Electric Ships' Log Company, Limited.—The statutory return of this company, made up to the 7th May, 1884, was filed on the 26th ult. The nominal capital is £15,000 in £5 shares, but only seven shares are recorded as taken up, and upon these nothing had been called. A return made up to 23rd of February, 1885, and filed on the 25th ult., contains the same statement.

South Eastern "Brush" Electric Light Company, Limited.—The annual return of this company, made up to the 13th ult., was filed on the 30th ult. The nominal capital is £51,000, divided into 19,600 shares of £2 10s. each, and 400 shares of £5 each; the latter being issued as fully paid. 19,600 of the £2 10s. shares are taken up, and £2 2s. 6d. per share has been called; the calls paid amounting to £42,462 10s., leaving £1,187 10s. unpaid. Since the last return the capital has been reduced from £100,000 in £5 shares.

South of England Telephone Company, Limited.—The registered office of this company is situate at 93, Cannon Street.

Changes of Office.—The registered offices of the following companies are now situate at 14, Austin Friars, E.C., viz:—The Telephone Company of Egypt, Limited; China and Japan Telephone Company, Limited; Oriental Telephone Company, Limited.

LEGAL.

Thornton v. The Electrical Power Storage Company.—Sittings at Nisi Prius, before Mr. Justice Day and a special jury, Tuesday. This was an action brought by an electrical engineer to recover damages (£700) for wrongful dismissal. Mr. Lockwood, Q.C., and Mr. Haigh appeared for the plaintiff; Mr. Webster, Q.C., Mr. Moulton, and Mr. R. W. Wallace for the defendants. In September, 1882, the defendants advertised, in the *Engineer*, for an engineer to manage their works at Millwall, and in October, the plaintiff having answered the advertisement, he was engaged as the works manager for three years, with a salary of £500 for the first year, £600 for the second, and £700 for the third year. In October, 1884, a Mr. Drake was appointed engineer to the company. The plaintiff was then instructed to confine his attention to the works, and on the 6th of October he was directed not to order any goods without first obtaining permission from the head office. On the 7th of October the plaintiff ordered ten tons of red lead at £12 a ton. On the 9th of October the plaintiff was dismissed, and his salary was paid him to the 12th of October, that being the day of the month on which the plaintiff's engagement had commenced. For the plaintiff it was urged that it was necessary to order the red lead, and that if in ordering it the plaintiff had been disobedient the matter was too trivial to justify the dismissal of the plaintiff. The dismissal was also justified on the ground that the plaintiff had not, as works manager, conducted himself with fidelity towards his employers. Particular matters were inquired into, and the case for the defendants was that in some instances the plaintiff had sold old lead and copper at very inadequate prices, and in particular it was stated that in July, 1884, the plaintiff had sold an old battery for £55. This battery with its contents consisted of from 18 to 22 tons of lead and several hundredweight of copper. It was stated that if this metal had been melted down and sold it ought to have realised from £150 to £160, but Mr. Brown, a metal merchant of Dalston, who purchased it, said it was not worth more than £90. Several other instances of what was alleged to be dealing with the company's property in a manner injurious to their interests were inquired into at some detail. In January last the plaintiff obtained employment with a firm, but instead of receiving £700 a year, which he would have done had he remained in the service of the defendants, his salary was only £300 a year. The jury returned a verdict for the plaintiff—damages, £80.

CITY NOTES, REPORTS, MEETINGS, &c.

Direct Spanish Telegraph Company, Limited.

THE twenty-third ordinary general meeting of this company was held at the Cannon Street Hotel on Monday, Sir James Anderson, chairman of the company, presiding. Very few shareholders were present. The report of the directors for the half-year ended December 31st, 1884, has already appeared in the REVIEW.

Mr. Ch. Gerhardi, the manager, having read the notice convening the meeting and the minutes of the previous meeting, which were confirmed,

The Chairman said, before moving the adoption of the report, he would as usual make such remarks as occurred to him upon facts that the shareholders ought to be cognisant of. His first remarks would be rather against the company; at all events, they would tell them the worst side. Then afterwards he would tell them what in his opinion were the prospects of the company. He would begin by saying that since he became a director of the company he had found to his regret that the old cable was in such bad order that they could not say how much it would take to put it in order or when it would be done. In the meantime the company had not money sufficient to expend on any satisfactory or extensive inspection or overhauling of it, and in the second place they had not at the present time a ship available; all the ships, owing to the present war, were taken up by telegraphic purposes abroad, and none but very expensive ships could be got. That being the case, they could very well afford to wait another season, by which time they hoped to have a larger revenue in hand and one of the Eastern Company's cheapest ships to effect the repair, or, at all events, the overhauling. They had lost considerably in their revenue this year owing to two causes: first, the cholera in the Mediterranean, which induced the Spaniards to impose quarantine at all the ports, thus driving the commercial men from Bilbao and Barcelona who were their best customers; next, the land lines in Spain had been working very badly. Spain, he was sorry to say, had a deficit in her budget to such an extent that she had been for the last two years unable to expend any money on the repair of telegraphs. The result to this company was unfortunate, because the lines were so bad that telegrams were very slow coming either by this company or by the Eastern Company. These were two causes of their present unfortunate position; but there was still another. Some year or two ago they adopted the word-by-word system, by which merchants could send one word to answer any purpose they thought proper, and the Telegraph Conference five years ago decreed that the public should have eight languages with which to form their codes and make the words of those languages mean anything they liked; at the same time the stipulation was that only the words should be used which were common to the usage of those eight languages. Unfortunately there had arisen during the last year or two, especially within the last twelve months, a number of enterprising gentlemen who manufactured those codes, totally disregarding all language. They put odd syllables together to make such combinations as had to the companies most disastrous results, the fact being that they carried three messages now for the price of two two years ago. These were the bad points, and he would now state how they proposed to overcome them. They were doing all they could at Madrid, with all the diplomatic influence they could bring to bear on the Spanish Administration, to get the lines put in better order. He had a long letter that morning, a telegram the day before and another telegram last Saturday, reporting progress; it was not so good on Saturday, but was better that morning, and he hoped that in the course of some time they would have the lines in Spain put in first-class order. That alone would give them some increase of traffic. Then there had been, as no doubt they all knew, a commercial treaty just passed between Great Britain and Spain which had long been in abeyance, and that, they thought, ought to make a great difference in their traffic. There had been a differential tariff against English trade for a considerable number of years, and that had now been removed. He believed he had read the previous day that the matter had passed the Cortes in Madrid. He would now allude to the main reason for which he came on that board, and for which the Eastern Company sought to get an interest in the affairs of the Direct Spanish. They would see by the maps that the Eastern Company had a land line through France, and land lines through Italy, through Austria and Germany, and through Russia, and they had long thought it desirable that they should also have one through Spain. Should they succeed in having a good through line in Spain, the same as they had through France, the Eastern Company then proposed to take a new cable from Malta through Carthagena to Gibraltar, thus diverting a considerable amount of traffic to the Bilbao cable. They were trying by their agents in Spain, backed up by the highest diplomatic influence in this country, to get a through line from Spain. That, and the new commercial treaty between Spain and this country should, he thought, at all events give a new phase to their traffic and an important addition. At any rate it was all that could be done. Then they had the Telegraph Conference coming off in August, at which the different telegraph administrations—by that he meant the Governments of Europe—would have their say about the abuse of code-language, which was simply ruinous to commercial companies. He did not know that he had any other remarks to make. The accounts were simple, and any little increase or decrease here and there was not worth reverting to compared with the main object of getting the company to a dividend-paying basis. Until the traffic increased, and until they got good lines in Spain, he did not see any specially encouraging features worth reverting to or worth thinking about. He concluded by moving the adoption of the report and accounts.

Mr. Edmund Etlinger, a director, seconded.

A Shareholder asked how much money had been expended on the old cable. It was a question whether they ought not to get rid of that cable altogether. Could the Chairman give any idea of what it would cost to repair it? He believed it was a halter round their necks, doing the company a great deal of harm.

Mr. Baker thought the report was very unsatisfactory. He proposed that they should overhaul the old cable, for which the ordinary capital was issued, and he thought the time had arrived for calling up the remaining £1 per share for that purpose.

Mr. Cochrane asked that it should be stated what was the amount of interest in this company held by the Easterm Company. He did not look with any great alarm on the fact that the dividend had not been paid on the preference shares, because it was accumulating. He desired to know what the item of £120, "amounts recovered," was derived from, and would like to know something further of the cause of the retirement of two of the directors, Mr. Bannatyne and Mr. Scott. Two of the three directors remaining were connected with the Eastern Telegraph Company, and he submitted that they had a possible interest not quite in harmony with the interests of the Direct Spanish Company. It was quite true they were in good hands, but he did not think they would be doing quite wisely in reappointing Sir James Anderson, leaving the majority of the board in the hands of the Eastern Company. On this point he thought it desirable that some committee should be appointed to discuss some other mode of life than that presented.

The Chairman, in replying to the various questions and remarks, said they had only one line to Bilbao, and that had never been a good one. About £30,000 had been expended on the old cable. ["How much is likely to be spent on it?"] That no living man could tell. They might bring forward the question of getting rid of the cable some time hence, but they ought first to investigate it at two or three points, and see if all parts were equally bad; the points with which they were familiar were very bad, and it did not appear that the cable was ever suitable for the special kind of water in which it was laid. The directors had always thought of the £1 uncalled, but they had kept that in reserve for the land lines which they hoped to get the concession to make from Bilbao to Barcelona; and they had a notion at one time of taking the Eastern cable up to Barcelona, and this would have been very useful for that purpose. They had offered to Spain—that country could not find the money—to put the land lines in repair so as to get their revenue, if they would return the money gradually by foregoing the transit fees which would otherwise have to be paid. They, therefore, thought it better to keep the call unpaid to meet any event of that kind. He did not see that it was fair to assume that it would suffice for the overhauling of the cable; he did not think less than £20,000 would be sufficient for that purpose. Mr. Etlinger told him, too, that there was a legal question whether they could spend that £1 in repairs. With regard to the case before counsel as to the payment of preference dividends, he had held the same opinion as most of them, and it was with very great regret he found that they could not pay some of the preference dividends. There was one clause, in Mr. Horace Davey's opinion, that if it was necessary, in the opinion of the directors, it could be postponed; and he (Sir James) thought some of it might have been paid. But really the revenue was too small. The £120 recovered, and the retirement of Mr. Bannatyne and Mr. Scott had been referred to. He wished it had not. In the course of negotiations in other matters he could not help seeing that there was an opposition cable to this being projected by the Silvertown Company, of which Mr. Bannatyne and Mr. Scott were directors, and he felt it his duty to call their attention to the fact. He must do them the justice to say that they resigned at once. They had not had their attention called to that particular portion in the proposed West African system before, and now they resigned and Mr. Bannatyne sent back his fees: that was the £120 recovered. They had spoken strongly about the Eastern Company coming into this, and seeking to absorb it. They did not want to absorb it. He held the opinion that a joint purse would be to their joint interest, especially in the event of a European disturbance. Mr. Pender was on his way to Lisbon, where he hoped to meet some of the authorities respecting the matters of which he had spoken. The Eastern Company had taken 30,000 ordinary shares, and, of course, it would not be alarmed at having to pay a matter of £3,000. They had no view but to promote efficient telegraphy without ruinous rivalry. He had been criticised for being connected with so many companies, and he would very gladly belong to fewer, but it was to the advantage of the shareholders that the different telegraph companies were in the hands of the same people, for else there would be a rivalry that would be simply disastrous.

The motion before the meeting, for the adoption of the report and accounts, was then put, and carried unanimously.

A Shareholder asked if the opposition cable spoken of was likely to be carried out.

The Chairman said he did not think the concession was likely to be given, and he believed that part of the project was abandoned.

Sir James Anderson and Mr. Etlinger were re-elected directors and the auditor, Mr. Herbert Duke, was re-appointed.

A vote of thanks to the chairman terminated the proceedings.

The Varley Electric Patents Proprietory, Limited.

THE prospectus of this company states that it is formed to acquire and develop certain patents granted to Mr. F. H. Varley and others for rigid and flexible carbons, storage or regenerative batteries, electric meters, dynamos, arc and incandescence lamps, electro-chemical and other filters, &c., to manufacture and deal in such appliances, instruments and accessories, as are required by the various companies, corporations, and other users of electricity, and to carry on the business of electrical engineers generally.

The company's patent carbon is an entirely new departure, and possesses advantages over carbons made by any other known process. When manufactured in sufficient quantity its cost is infinitesimal, the bye products almost covering the cost of manufacture; and its economy in consumption is considerable, whether it be used as battery plates, electrodes for arc lamps, filaments for incandescence lamps, diaphragms for electro-chemical and other filters, packing for steam engines, or the infinite variety of purposes for which it is available. Apart, therefore, from its value to electrical engineers it is likely to be in great demand by manufacturing chemists, sugar refiners, brewers, and generally in connection with the arts and manufactures.

Hitherto there has been nothing between the comparatively cheap, many-hundred-candle-power arc lamp, and the costly small-candle-power incandescence lamp, the result being that, for limited areas, the expensive lighting by incandescence has had to be used or lighting by electricity abandoned. This will no longer be the case. The "Miniature" arc lamps offered by this company are available for business, domestic, theatrical, and other purposes. The subdivision of the arc, consequent upon the use of this lamp, occasions scarcely any loss of luminous energy, and renders the cheap arc-system equally available for shops, drawing-rooms, or churches. This company can run as many of their "Miniature" arc lamps as are now run by the incandescence system from the same power, each lamp giving at least three times the light of an incandescence lamp. This subdivision depends upon the use of the patent carbon, which is made in various forms, and rigid or flexible, according to the purposes to which it is to be applied. The electric candles used in the "Miniature" arc lamp are made of flexible carbon, which is coiled on spools and paid off by mechanism electrically controlled. These lamps can easily be made to run for one hundred consecutive hours without attention—in fact, they can be made to last for months, the limit of duration being only determined by the working size of the spools. For mining and many other purposes this durability is of great importance.

The "Miniature" arc lamp, though specially applicable for the above purposes, is still more so for the lighting of streets.

While giving greater prominence to the "Miniature" arc lamps, this company is not behind others with the larger lamps. These give a luminosity at least equal to that of the lamps of any other company, and being constructed on the same lines as the miniature lamp, the economy in attendance, consequent on their durability, is considerable.

This company's patent boro-carbon incandescence lamp possesses features of marked novelty, and can be used instead of the "Miniature" arc lamps where lighting by incandescence is preferred. The patent holder for the same is neat, simple and effective.

The reversible primary battery, suitable for electrical storage, is another great scientific novelty, which has been introduced by this company, and is destined to influence greatly the future of electricity. It is made in a variety of forms, the chemically indestructible carbon, which is used in it and for the first time makes a zinc and carbon couple possible, lending itself to numerous modes of treatment. In charging this battery the zinc is electro-deposited in metallic form, and in discharging it is thrown back again as a zinc salt without appreciable waste of material. To maintain it in constant working order, it is only necessary to provide the current for charging, and to replace the water decomposed or lost by evaporation. In order to obtain the maximum of depolarising surface in the minimum of space, flexible or other porous carbons are generally used, but in batteries for special purposes carbons are also used of the rigid and non-porous types. The advantages of such a storage battery are self-evident.

The patent carbon is used to great advantage in Leclanché and similar batteries, where, as it gives a considerable increase of current, it is specially suitable for telephonic and telegraphic purposes.

A great advance in the practical application of electricity has been made in this company's patent electric meter, which, as a scientific and practical success, combines unusual accuracy with perfect simplicity. This meter has been well described by Mr. Varley in the Journal of the Society of Arts, of December 12th, 1884, where, agreeing with the remarks of Mr. W. H. Preece, F.R.S., as to the scientific accuracy of the measurement of electricity by the electro-deposition of metals, he said, "There can be no doubt the measurement of electricity by the electro-deposition of metals as used in the Edison meter is scientifically correct, and in every way well suited to the laboratory, but as a meter for practical use it is very defective in that, not being a self recording instrument, it cannot be read by the unskilled consumer. I have given great attention to this part of the subject, and in conjunction with Mr. J. R. Shearer, have brought out a meter which removes the whole of the difficulty. In its simplest form it consists of a hydrometric float carrying an electrode, and graduated to indicate the amount of current passed by the electro-deposition and dissolution of metals. The other electrode is attached to the containing jar." It is evident that, as the passage of a given quantity of electricity invariably dissolves a definite quantity of metal, all the forms of mechanism capable of being used for weighing purposes are available for recording the consumption of electricity by this meter. In one form at present made, the recording mechanism consists of a scale beam having at one end the hydrometric float with electrode attached, and at the other end a scale-pan carrying a number of weights. A pointer fixed at the centre of the upper surface of the scale-beam serves to indicate on a graduated scale the amount of current that has passed, the beam being tilted in proportion to the amount of metal dissolved, which exactly corresponds to the amount of current. When a current equal to one reading of the scale has been used, the pointer is again set to zero by removing one of the weights from the scale-pan, each weight corresponding to one reading of the scale. For example, on a meter having a scale divided into 100 divisions, with each division representing 1,000 ampères, let the pointer stand at the 50th division with two of the weights removed the reading will be 250,000 ampères. Another form is being prepared on the principle of the steelyard, with single shifting weight, the pointer and electrodes being arranged as in the scale-beam pattern.

As the result of the inventions before described, this company will be able to undertake local installations, and, where mains fed from central stations are available, to supply the consumer with lamps suited to his requirements, fed from regenerative batteries, fixed and charged on his own premises like his water cistern, in combination with an electric meter at once accurate and easily read.

This company has taken over the stock and plant of the Varley Patents Proprietory at Mildmay Park, and has secured as managing director the services of Mr. F. H. Varley.

The Jablochkoff Electric Light and Power Company, Limited.—Creditors are required, on or before May 11th, to send their names and addresses, and the particulars of their debts and claims to the liquidator of the company, Mr. W. Augustine Spain, 76, Coleman Street, Bank, E.C.

Western Union Telegraph Company, Limited.—A dividend of 1½ per cent. on the capital stock for the quarter ended March 31st, is payable on the 15th inst. to shareholders registered on the 20th ult.

TRAFFIC RECEIPTS.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending March 27th were £2,623, after deducting the fifth of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited.

PROCEEDINGS OF SOCIETIES.

The Society of Telegraph-Engineers and Electricians.

AN ordinary general meeting of this society was held on Thursday, March 26th, Mr. C. E. SPAGNOLETTI, President, in the chair. The minutes of the last ordinary meeting having been read and confirmed, and the list of new, and proposed new, members, announced, a paper on "The Seat of Electromotive Force in a Voltaic Cell," by Prof. Oliver J. Lodge, was read. This paper was similar to that published, with full illustrations, in the numbers of the REVIEW for October 4th, October 18th, and November 2nd of last year.

The discussion on the paper was adjourned till the 26th April.

NEW PATENTS—1885.

3845. "Thermo-electric generators." H. WOODWARD. Dated March 25.

3850. "Shunt or contact variers or sutomatic cut-outs or short circuiters for magneto call or signalling bells or for other purposes." G. A. MASON. Dated March 25.

3851. "Telephones." P. M. JUSTICE. (Communicated by F. Blake.) Dated March 25. (*Complete.*)

3854. "Electric generators." W. HARTNELL. Dated March 25.

3857. "Electrical switches." S. Z. de FERRANTI. Dated March 25.

3888. "Making electrical batteries." L. P. MERRIAM. Dated March 26.

3938. "Telephones." G. BINSWANGER. (Communicated by J. Ochorowicz.) Dated March 27.

3941. "Dynamo-electric machines." J. SWINBURNE. Dated March 27.

3942. "Electric measuring instruments." J. SWINBURNE, S. EVERSHED. Dated March 27.

3943. "Electrical contact devices for fire alarm apparatus." W. R. LAKE. (Communicated by F. Bechtold.) Dated March 27.

3944. "Galvanic batteries." W. J. P. BARBER-STARKEY. Dated March 27. (*Complete.*)

3967. "Switches or electrical current changers." J. MACKENZIE. Dated March 28. (*Complete.*)

3968. "Apparatus for opening and closing electric circuits." J. MACKENZIE. Dated March 28. (*Complete.*)

3969. "Fusible connections for electric circuits." J. MACKENZIE. Dated March 28. (*Complete.*)

3970. "Electrical circuit closers." J. MACKENZIE. Dated March 28.

3987. "Portable electric lamp." A. F. and G. ROSE. Dated March 28.

3991. "Automatic switches for use in charging secondary batteries or accumulators." T. R. JONES, R. BELFIELD. Dated March 28. (*Complete.*)

ABSTRACTS
OF PUBLISHED SPECIFICATIONS, 1884.

1799. "A compound self-sustaining filament for incandescent lamps." J. G. W. ALDRIDGE. Dated January 21. 6d. A hollow filament is formed from a mixture of gluten or cellulose, or from rag-pulp, in combination with salts of tungsten and soda. The hollow filament is inserted into an elastic fireproof envelope made principally of fire clay. The ends of the filament are coppered and connected with the upper ends of brass or copper conducting tubes. These tubes may be made of any other equally good conductor of heat and electricity. The lower ends of these tubes are connected by cotton wicks with reservoirs of paraffin or other mineral oil, which, being vaporised by the heat of the tubes, is conveyed in a gaseous state to the interior of the filament and deposited in it.

2327. "Improvements in galvanic batteries." J. RAPIEFF. Dated January 29. 8d. Relates to improvements in the construction of galvanic batteries and the arrangement of their parts so as to obtain:—A. More complete circulation of liquid or liquids used in batteries to effect a constant washing of electrodes by more or less fresh liquid or liquids and to ensure an entire consumption of the same, and therefore a more uniform and continuous action of the batteries, also to obtain a reduction in the electrical resistance of the same. B. Prevention of local action upon the electrode or electrodes and to cause a more uniform wear of the same. C. Reduction of polarisation of the batteries and increased constancy of the same by the use of a negative electrode or electrodes of special construction. D. More economical use of liquids and electrodes by avoiding the contact of the said liquids between themselves or with the electrode or electrodes, when they are not in actual use. E. More simple, expedient and convenient means of charging and discharging the batteries; the regulation of their strength, or in other words their supply of electricity; and of closing or opening the circuit, *i.e.*, forming or breaking the contact between the liquids and electrodes.

3570. "Improvements in dynamo-electric machines." J. H. GREENHILL. Dated February 19. 6d. The inventor employs a "ring" armature, built up by preference of thin iron sheets, which for the purpose of ventilation and the prevention of what are termed Foucault currents have small air spaces between all or some of the iron sheets, or portions of them, or they may be otherwise insulated in part or in whole. The ring thus formed is constructed of a number of segmental sections, which have by preference pieces or "spokes" projecting both towards the centre, and radially (outwards). The copper wires or sheets in which the current of electricity is set up are wound circumferentially on the ring in the spaces between the projecting spokes, but electrically insulated from the iron and each other. The segmental sections, when placed in position and secured, form a complete ring, but each segment, having one or more projecting spokes and coils of copper, is capable of being removed when desired without disturbing the other segments. The cylindrical ring or rings (there may be more than one) may be supported by brass, or other non-magnetic cylinders, spokes or centres, and mounted on a revolving shaft to which the commutator is attached, the latter being connected to the copper coils in the usual manner.

3666. "An improved electric log and revolution indicator." P. SCOTT and A. T. H. SCOTT. Dated February 20. 6d. The log and engine counter may be used separately, but would generally be combined in one instrument in steam ships. Each is based on the employment of a combined time glass and electrical circuit closer, whereby an electrical circuit is kept closed during any unit of time adopted in combination with a make and break actuated by the log or by the shaft whose revolutions are to be counted, and with a step-by-step recording instrument, whereby the making and breaking of the circuit during the given unit of time is recorded or translated in the form of the corresponding number of knots per hour or revolutions per minute, or according to any other system of calculation preferred. The combined time glass and circuit closers consist of a mercurial time glass resembling a sand glass, in which mercury takes the place of the sand. At the neck, or other convenient part of the glass, two wires are inserted and terminate within the bore, so that the mercury in its passage must place them in electrical contact, these wires being connected with respective portions of a battery circuit. They may also serve as an axis upon which the time glass may be oscillated. In the same circuit are placed the electro magnet of the step-by-step recording instrument and the make and break for producing the necessary interruptions in the current for the operation of the said instrument.

3970. "An electric light arc lamp." H. F. JOEL. Dated February 26. 6d. The inventor constructs an electric light arc lamp with a compound solenoid coil, having a movable core made of iron tube; through the centre of the core the top carbon holder passes. The special feature of the invention is a mechanical movement for regulating the rise and fall of the carbon holder and top carbon under the influence of an electric current. The inventor takes a long double link or hinge, and pivots one end to the underside of the core, the other end of the link he pivots immediately underneath to the bottom of the inside of the case. This hinge forms a knuckle, with its sides at an angle of about 90° one to the other, and the middle hinge joint projecting outwards. He connects the hinge to the carbon holder by means of an additional link, one end of which is attached to the lower link of the hinge, and the other end to a clamping ring, which encircles the carbon rod holder. He provides an adjustable stop for the projecting hinge joint to butt against. When not in action the iron core is supported by the hinge, and the clamping ring, which is made a little larger in diameter than the carbon rod holder, allows that rod free movement. When an electric current is sent through the lamp, the iron core is sucked up into the coil; this tends to straighten the hinge; the clamping ring is tilted by its connecting link and clamps and lifts the carbon holder and top carbon, and thus forms the arc between the two carbons, when the arc increases in length and resistance; the reversing action of a shunt coil on the solenoid causes the core to descend—this carries the connecting link and clamping ring, and with it the carbon holder, until the main coil again preponderates and the reverse action takes place. The play in the ring when tilted, which is adjustable, is the extent of the permanent feed given to the carbon by this action.

4088. "A new or improved method and apparatus for working and controlling electrically railway signals and points." E. TYER. Dated February 28. 6d. In working the semaphore arm of a distant signal, the arm is weighted so that, if left to itself, it will take the horizontal or "danger" attitude, and has to be pulled down to "safety." At or near the signal post is fixed an electro-dynamic machine, which can be put in circuit with a battery at the signal post or cabin, or elsewhere, so that its armature is caused to revolve rapidly, and thus by suitable speed-reducing gear is made to turn a barrel winding a chain, or to turn a pinion moving a rack, so as to pull down the semaphore to its "safety" attitude. The inventor arranges the gearing and an electrical contact in such a manner that when the semaphore is pulled down the current of electricity ceases, but the semaphore remains held down by a detent, or its equivalent, applied to the gearing. This detent is worked by the armature of an electro-magnet, subject to an electrical current from another source, so that the operator at a distant station, or operators at several stations, or the passage of a train over a part of the line provided with contact apparatus, can release the detent, permitting the semaphore to return to the "danger" attitude.

4121. "Improvements in the manufacture of filaments for incandescent or glow lamps." J. SWINBURNE. Dated February 29. 2d. The inventor uses cotton, paper, or any other suitable form of cellulose, and acts on it with very strong nitric acid. This converts it wholly or partially into a jelly-like substance. He washes this and heats it with a suitable reducing agent, and so converts it into a less combustible substance of somewhat similar physical appearance. Thus a suitable cotton or linen thread may be passed continuously through strong nitric acid; then through water; and may then be boiled in a solution of potassium or ammonium sulphide. After reduction, the filaments may be carbonised and enclosed in bulbs in the usual way.

4280. "Improvements in points or switches for sidings and branches of Telpher lines." A. C. JAMESON. Dated March 3. 8d. Consists in arranging the point or switch so that it moves in a vertical plane instead of a horizontal one, thereby avoiding certain inconveniences in the construction and working of the same.

4683. "Improvements in dynamo-electric machines." W. H. SCOTT and E. A. PARIS. Dated March 11. 6d. In carrying out the invention there are four, or there may be any even number more than two, magnets and the armature is placed to rotate in the space between the poles of these magnets and an iron core. The armature is in the form of a hollow cylinder or drum, having its circumference made of paper or other suitable material surrounding the iron core, which is carried on a fixed central spindle. At the ends of the drum the paper or other material is connected to an annular piece or ring of insulating material, and this ring is recessed on its inner side to receive part of a flat brass ring, and this brass ring is fixed in a recess formed to receive the other part of it in a boss formed on a tubular piece through which the central fixed spindle passes. By this convenient arrangement the tubular piece and its boss which forms the end of the drum at either end may be removed to give access to the iron core or interior when requisite, the improved method of winding the wire on the drum enabling this operation to be done without disturbing the wire

The armature is driven by means of the tubular piece, and the central fixed spindle is formed hollow, either through its whole length or a portion thereof, so that a tube or pipe may be passed through the hollow spindle and through the iron core into a hollow or oil-well formed in the iron core. The oil used in oiling the tubular pieces will find its way into this hollow or oil-well, and can be withdrawn therefrom by the tube or pipe when required. The wire of the armature is wound upon the drum in the following special manner:—The periphery of the drum is divided longitudinally into a number of equal parts, and on commencing to wind the wire is taken from the middle of one of the equal parts and the single wire is taken from that part to a point opposite, so as to form the chord of an arc of the circle of the drum. This point is one end of an equal part, thence the wire is taken and wound longitudinally along the drum, across its other end, and back along another equal and parallel part of the circumference of the drum, thus making the single wire and the rows of wound wire to form, as it were, approximately two sides of a square, looking at the drum end. The wire is thus wound longitudinally on the drum over the single wire until one half of the equal part is taken up, and then the wire is passed to another equal part opposite, so that looking at the end of the drum the single line of wire, and the succeeding rows of wound wire, form approximately the two sides of an imaginary square. After winding the wire, as in the first case, until half of an equal space is covered, the single wire is again passed to another point in the circumference, and the process repeated until the whole circumference of the drum is covered with wire. Each single wire crossing the end of the drum is connected to the commutator. Any number of layers of wire may be wound over the first one, and they may be connected up either in series or in parallel. By this improved method of winding, and by using four brushes on the commutator, they can be made to bear on the commutator at such places that only those coils which are in the magnetic field are in circuit, whilst those which are not in the magnetic field are short circuited.

CORRESPONDENCE.

The Invention of the Magneto Telephone.

As a supplement to my former letters on this subject, I send you a translation of a few sentences from a small book published in Paris in 1868, and received at the library of the British Museum the same year.

"Some years hence, for all we know, we may be able to transmit the vocal message itself, with the very inflection, tone, and accent of the speaker; a result which in these days of science does not appear to be impossible."

"Sound, of whatever kind, is produced by a series of vibrations, more or less rapid, which setting out from a sonorous body, traverse the air and reach our ears."

"A vibrating plate produces a sound, and, according to the rapidity of the vibrations, these sounds are sharp or flat. At each of the vibrations the plate touches a small point placed in front of it, and their contact suffices to throw the current into the line. When the plate ceases to vibrate, and returns to its position of equilibrium, it no longer touches the metal point, and the current is consequently interrupted."

"By this means is obtained a series of interruptions more or less rapid, according to the sound waves of the voice; the current being thrown into the line and interrupted once for each of the vibrations."

"At the extremity of the line the currents enter an electro-magnet, which attracts another vibrating plate of size and quality identical with the former. Attracted and repelled very rapidly, exactly, and as rapidly, in fact, as the plate mentioned above, this second plate gives forth a sound which will have the same musical value as that of the other, as the number of vibrations per second is the same in both cases."

"Should this process be perfected it will be possible to transmit sound by means of the telegraph—to transmit a series of sounds, a tune, or spoken sentences and conversation."

The above description of the receiving telephone is clearly the combination of a plate of iron or steel, or other material capable of inductive action, with an electro-magnet.

There is the *plate*, not a bar, capable of inductive action, placed in front of and close to, but not touching the poles or pole of an electro-magnet; true, it does not say that the plate is held down all round its edge, but the fact that the word "*plate*" is used, and not "*bar*" nor "*tongue*," shows that the plate was to be held in such a way as not to vibrate as a tongue, but to vibrate tympanically. Would any skilled mechanic from that description use a bar or tongue fastened at one end? Would he not use a plate—that is, a piece of metal, flat, and of a uniform thickness? Would any such mechanic fasten such a plate at one point only, and leave it to vibrate as a tongue? Would not the form of the plate, whether square, oblong, oval or round, show conclusively that it should be fixed by at least two points, and this being done the plate will act tympanically.

I submit that the public knowledge in England before the 1st November, 1876, was sufficient to enable any skilled mechanic to make a magneto-telephone capable of repeating articulate speech. In addition to the above description of a telephone, there was published Bourseuille's description in the 3rd volume of "Du Moncel's, L'Exposé," &c., &c., from which I cite:—"Imagine that you speak against a sensitive plate so flexible as to lose none of the vibrations produced by the voice, and that this plate makes and breaks successively the communication with an electric pile; you may have at any distance another plate which will undergo in the same time the same vibrations." Another description and a drawing of a magneto-telephone forming part of the public knowledge was published in the Official Gazette of the U. S. Patent Office, in file at British Patent Office, 3rd July, 1876, and this was that of a telephone having a stretched membrane with an iron bar attached to it; and, again, another publication of a magneto telephone was that in the *English Mechanic* of 11th August, 1876, a gold beater's skin stretched with iron on the centre.

It cannot be gainsaid that these several publications do not give all the information necessary for any ordinarily skilled workman to make a good magneto-telephone. He is told there is to be a flexible iron plate fixed in front of a magnet, and he is told to fix it as a drum-head, or tympan, after the fashion of the gold beater's skin arrangement.

The drawings exhibited in the Official Gazette above referred to, and the publication in "Electricity" by Ferguson, in 1867, of Reis's telephone, give the information as to the manner of connecting the transmitter and receiver.

I ask, could not any skilled mechanic make a good magneto telephone from these publications, which formed part of the public knowledge before 1st November, 1876.

W. C. Barney.

March 30th, 1885.

[Would Mr. Barney favour us with the title of the small book mentioned at the commencement of his letter.—EDS. ELEC. REV.]

Dynamo Winding.

In answer to Mr. Moon's letter on this subject in your issue of to-day, it is, I think, only necessary for me to state that he has quite misunderstood the purport of my former remarks.

In these I merely drew attention to the fact that there were two solutions of the problem of converting a dynamo from series to shunt wound to give the same external and internal power at the same speed through the same external circuit, and adduced an example showing that in some cases the second solution would be of service.

The two solutions are both derived from the same quadratic equation. The comparisons I gave are between the two shunt wound machines, and are correct.

I had no intention of questioning the accuracy of Mr. Moon's results or the obvious fact that if a shunt wound and a series wound dynamo are both giving the same external current the armature current will be greater in the shunt machine.

I cannot understand Mr. Moon's inverted commas, nor his allusion to makeshift arrangements.

P. Cardew.

Chatham, *28th March*, 1885.

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